Environmental Impact Analysis Process

FINAL
ENVIRONMENTAL ASSESSMENT

STARLAB PROGRAM

17 AUGUST 1990

DEPARTMENT OF THE AIR FORCE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	AUGUST 17, 1990	Final, 1990

4. TITLE AND SUBTITLE
Environmental Assessment For The STARLAB Program

5. FUNDING NUMBERS
Ø

6. AUTHOR(S)
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Oak Ridge, TN 37831

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
HQ Space Systems Division/DEV
P.O. Box 92960
Worldway Postal Center
Los Angeles, CA. 90009

8. PERFORMING ORGANIZATION REPORT NUMBER
Ø

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
- see Block 7 -

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
Ø

11. SUPPLEMENTARY NOTES
N/A

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for Public Release; Distribution is unlimited

12b. DISTRIBUTION CODE
A

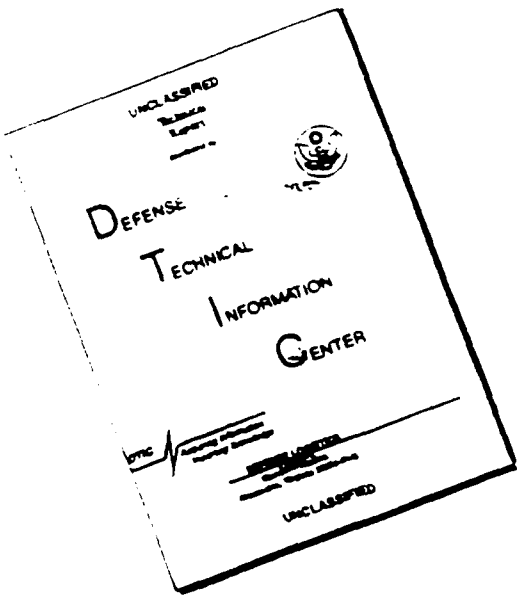
13. ABSTRACT (Maximum 200 words)

EA supports conducting a set of engagements & experiments using the electro-optical and laser systems to be installed aboard a space shuttle Flight.

14. SUBJECT TERMS	15. NUMBER OF PAGES
STARLAB EA	100
	16. PRICE CODE: Ø

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLAS	UNCLAS	UNCLAS	UL

DISCLAIMER NOTICE



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STARLAB PROGRAM

17 August 1990

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U.S. DEPARTMENT OF ENERGY
under
Contract No. DE-AC05-84OR21400

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ACRONYMS AND ABBREVIATIONS

ACHP	President's Advisory Council on Historic Preservation
AFOSH	Air Force Occupational Safety and Health
AFR	Air Force Regulation
AMOS	Air Force Maui Optical Station
ANSI	American National Standards Institute
ATP	aquisition, tracking, and pointing
CCAFS	Cape Canaveral Air Force Station
CFP	controlled firing process
CFR	Code of Federal Regulations
cm	centimeter
dBA	Decibels on the A-weighted scale
DOD	U.S. Department of Defense
EA	Environmental Assessment
EIAP	Environmental Impact Analysis Process
EIS	Environmental Impact Statement
ETR	Eastern Test Range
FAA	Federal Aviation Administration
FGFWFC	Florida Game and Fresh Water Fish Commission
FONSI	Finding of No Significant Impact
IED	illuminator energy density
IR	infrared
IRPA	International Radiation Protection Association
J	Joules
km	kilometer
LBD	Laser Beam Detector
LC 20	Launch Complex 20 (at Cape Canaveral Air Force Station)
LMP	Light Management Plan
LMSC	Lockheed Missile and Space Company
LSS	Laser Source System
m	meter
MAB	missile assembly building
MPE	Maximum permissible exposure
µrad	microradian
MRTS	Mobile Real Time System
mW	milliwatt
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act

NMFS	National Marine Fisheries Service
PEP	Payload Experiment Package
POCC	Payload Operations Control Center
PSD	Prevention of Significant Deterioration
RME	Relay Mirror Experiment
s	seconds
SDI	Strategic Defense Initiative
SDIO	Strategic Defense Initiative Organization
SHPO	State Historic Preservation Office
sr	Steradian
SSD/DEV	Space Systems Division/Environmental Planning Branch
STO	Space Test Object
SWAT	Short Wave Adaptive Technology
T&E	threatened and endangered species
TSP	total suspended particulate matter
USAF	U.S. Air Force
USASDC	U.S. Army Strategic Defense Command
USFWS	U.S. Fish and Wildlife Service
UV	ultraviolet
VTSP	video tracker signal processors
W	Watt
WHO	World Health Organization

SUMMARY

This environmental assessment (EA) has been prepared by the U.S. Air Force (USAF) in compliance with the National Environmental Policy Act (NEPA) and Executive Order 12114 to determine if significant environmental impacts would result from the Starlab program. The proposed action is to conduct a set of engagements and experiments using electro-optical and laser systems to be installed aboard a Space Shuttle flight. The purpose of these engagements and experiments is to advance the research program of the Strategic Defense Initiative Organization (SDIO), particularly that involving the acquisition, tracking, and pointing capabilities of the electro-optical and laser systems.

The activities involved in the Starlab program include (1) passive experiments for collecting and analyzing ultraviolet and infrared data to calibrate the electro-optical systems; (2) experiments using small space test objects deployed from the orbiter to sight the lasers and to demonstrate the capability of rapidly changing from tracking one object to acquiring and tracking a second; (3) ground calibration engagements that locate and actively scan sites on Antigua and Ascension Island with red and green lasers, which are then reflected back to the shuttle; (4) engagements with ground launched rockets (i.e., Starbird vehicles) that actively identify and track Starbird vehicles launched from Cape Canaveral and Wake Island and their plumes using green and red lasers; and (5) a Short Wave Adaptive Technology (SWAT) experiment that actively links the orbiter with the Air Force Maui Optical Station (AMOS) in Hawaii using blue and green lasers from AMOS and red lasers from the Starlab.

The National Aeronautics and Space Administration (NASA) is the mission manager for the proposed action, and the SDIO is the DOD sponsor for the Starlab program. The USAF Space Systems Division and the U.S. Army Strategic Defense Command (USASDC) are the experiment program offices. As mission manager, NASA is responsible for overall operation and coordination of the Space Shuttle. The USAF Space Systems Division is responsible for the Starlab payload in the orbiter and the SWAT experiment. The USASDC is responsible for the construction of the launch sites and the launch of the Starbird vehicles. The USAF Space Systems Division is the lead agency for preparing this EA, and NASA, SDIO, USASDC, and the Department of State are cooperating agencies.

A major issue addressed in this EA is the potential exposure of people and wildlife to laser beams. The USAF has prepared extensive analyses of potential laser effects, which are reviewed and evaluated in this EA. Other issues that are discussed and evaluated in the EA include potential impacts of Starlab activities at Cape Canaveral and Wake Island (Starbird launch sites), and Maui (site of the SWAT engagement) on land use, ecological resources, endangered and threatened species, and socioeconomic resources.

Detailed safety analyses of the effects of laser systems prepared by the USAF and independent calculations and analyses made in preparing the EA indicate that no significant impact to humans or wildlife would occur from exposure to lasers because of the low probability (1×10^{-9}) of people or wildlife seeing a pulse of 25 nanoseconds.

Environmental impacts of construction and operation of the ground calibration sites on Antigua and Ascension Island will be considered in separate environmental review documents prepared in compliance with Air Force Regulation 19-3.

Construction of facilities for Starbird launches at Wake Island and Cape Canaveral Air Force Station (CCAFS) have been completed. Environmental impacts of construction were evaluated in an EA prepared by USASDC in 1987 (U.S. Army 1987). This EA includes an assessment of the changes that have occurred since the USASDC EA was published. The USASDC has recently prepared a Light Management Plan (LMP) for the CCAFS launch site that includes mitigation measures to prevent significant impacts to endangered species of sea turtles at CCAFS. The U.S. Fish and Wildlife Service (USFWS) has reviewed the LMP and has concurred that sea turtles will not be affected by operational activities at Launch Complex 20. No significant impacts are likely to occur to endangered and threatened species, migrating sea birds, or historic and cultural resources at either Wake Island or CCAFS. Consultation required under the Endangered Species Act and the National Historic Preservation Act has been completed for development and use of the Starbird sites.

No construction would occur at the AMOS facility on Maui. Operations for the SWAT experiment have been evaluated and no significant adverse impacts are anticipated. The USFWS has reviewed the project and concurred with the findings of this EA that the project would be expected to have little, if any, impact on any federally-listed endangered or threatened species.

1. INTRODUCTION

1.1 PURPOSE AND NEED

Former President Reagan announced on March 23, 1983, that he was directing a "comprehensive and intensive effort to define a long-term research and development program to begin to achieve our ultimate goal of eliminating the threat posed by strategic nuclear missiles." To implement this directive, the President created the Strategic Defense Initiative Organization (SDIO), which was chartered to oversee activities of various U.S. Department of Defense (DOD) offices related to the Strategic Defense Initiative (SDI).

The Starlab program is an SDI activity that consists of a dedicated Space Shuttle mission having the objectives of demonstrating "proof-of-concept" for several space-based defense experiments and new concepts for performing strategic space experiments using the Space Shuttle/Spacelab capability. Under a Memorandum of Agreement between the National Aeronautics and Space Administration (NASA) and DOD, NASA will provide launch services for the Space Shuttle and overall Starlab mission coordination and support. SDIO is the DOD sponsor for the Starlab program (NASA and DOD 1989), and the U.S. Air Force (USAF) is responsible for developing the Starlab payload and conducting the experiments. The U.S. Army Strategic Defense Command (USASDC) is responsible for the ground launched vehicles (i.e., Project Starbird) associated with Starlab.

The Starlab program includes a series of experiments that use electro-optical and laser systems aboard the Space Shuttle and on the ground. These experiments are designed to (1) demonstrate acquisition, tracking, and pointing (ATP) of laser systems; (2) collect plume and background information to narrow phenomenology uncertainties; and (3) provide a basis for making an informed decision on the design of a weapon ATP system. Starlab includes experiments that use laser beams propagated by equipment from the orbiter and to and from the ground. The laser experiments involve (1) calibration of the electro-optical systems, using objects deployed from the orbiter (i.e., space test objects) and scoreboards at ground calibration sites on Antigua and Ascension Island; (2) ATP activities associated with Starbird test vehicle launches from Wake Island and Cape Canaveral, Florida; (3) participation in the Short Wave Adaptive Technology (SWAT) experiments at the Air Force Maui Optical Station (AMOS), Hawaii; and (4) wavefront control experiments. In addition to these laser experiments, background data on the composition of visible and other spectral radiation from planets and stars would be collected during the Starlab mission to assist in calibrating the electro-optical systems.

1.2 SCOPE

This environmental assessment (EA) has been prepared pursuant to Sect. 102 of the National Environmental Policy Act (NEPA) of 1969 (Pub. L. 91-190, as amended), as

implemented by regulations promulgated by the President's Council on Environmental Quality (40 CFR Parts 1500–1508), Air Force Regulation (AFR) 19-2 (Environmental Impact Analysis Process), Executive Order 12114 (Environmental Effects Abroad of Major Federal Actions) and AFR 19-3 (Environmental Impact Analysis Process Overseas). The principal objectives of NEPA are to ensure that careful consideration is given to environmental aspects of proposed actions in federal decision-making processes and to make environmental information available to the public before decisions are made and actions taken. The purpose of an EA is to briefly provide sufficient information and analysis for determining whether to prepare an environmental impact statement (EIS) or a finding of no significant impact (FONSI) (40 CFR Part 1508.9).

Executive Order 12114, which is implemented by the USAF under AFR 19-3, is applicable because the Starlab program involves activities in foreign countries and over international waters. Under AFR 19-3, an EA addressing USAF activities overseas should provide "enough information to determine whether the proposed action is major and whether it significantly harms the environment of the global commons" (AFR 19-3, Attachment 1, §2.e.1). The global commons includes "geographic areas that are outside the jurisdiction of any nation, including the ocean outside territorial limits . . ." (AFR 19-3, §1.f). USAF activities that affect the environment of a foreign nation must be carried out in a way that allows for consideration of the environment as well as for existing international agreements and the sovereignty of other nations (AFR 19-3, §2.c). The environmental impacts for the proposed ground calibration sites on Antigua and Ascension Islands will be reviewed separately under AFR 19-3 (Attachment 2, §6). SDIO has designated the USAF, Space Systems Division, Environmental Planning Branch (SSD/DEV) as the lead agency for preparing this EA. Cooperating agencies are SDIO, NASA, USASDC, and the Department of State.

Six separate activities that together comprise the Starlab action are evaluated in this report. The document builds upon other NEPA documents, as well as presenting new information. Previous NEPA documentation that has been prepared to address environmental concerns associated with Starlab activities includes (1) an environmental impact statement (EIS) prepared by NASA on the Space Shuttle Program (NASA 1978) and supplemented by an environmental resources document (NASA 1986), (2) an EA prepared by the USASDC on the Starbird project (U.S. Army 1987), and (3) an EA and supplement prepared by the USAF on the proposed Relay Mirror Experiment (RME) (USAF 1987, 1988) conducted at AMOS. The NASA EIS and the environmental resources document address the environmental impacts of developing and operating the Space Shuttle Program. The USASDC's Starbird EA, FONSI, and Light Management Plan (LMP) address the construction, operation, and decommissioning of launch facilities at Wake Island and Launch Complex 20 (LC 20) at Cape Canaveral. The EA on the RME addresses the environmental effects of an experiment using lasers at AMOS that are very similar to those proposed for use during the Starlab mission.

In determining the range of issues that should be addressed in this EA, site visits were made to Wake Island, Hawaii, and Cape Canaveral. As part of the site visit to Hawaii, discussions were held with the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) to obtain general information about fish and wildlife resources, including

endangered and threatened species, at the AMOS and Wake Island sites in the Pacific. As a result of these discussions, USFWS and NMFS staff visited Wake Island to collect additional information on ecological habitat. Reports of this site visit are included as Appendices A, B, and C of this EA. An additional survey of seabird nesting at construction sites on Wake Island was conducted immediately prior to initiation of construction by the Pacific Division Naval Facilities Command (Appendix D). Other agencies, organizations, and individuals contacted during preparation of the Starlab EA are identified in Sect. 5.7.

A major issue addressed in this EA is the potential exposure of people and/or wildlife to laser light. The USAF has prepared extensive analyses of potential laser effects [Payload Experiment Package (PEP)-20, LMSC 1989], which are summarized and evaluated in this EA. Independent calculations have also been made in preparing this EA to verify these results. Other issues that are evaluated include potential impacts of operational phases of Starlab activities at Wake Island, Cape Canaveral, and Maui on land use, ecological resources, endangered and threatened species, and socioeconomic resources.

2. PROPOSED ACTION AND ALTERNATIVES

2.1 DESCRIPTION OF THE PROPOSED ACTION

The proposed action would use the Space Shuttle (Fig. 2-1) to conduct and complete SDI experiments within a scheduled 7-day mission in the second quarter of 1992. These experiments would use Spacelab hardware located in the orbiter bay to interact with ground sites, missiles in flight, and space test objects (STOs) deployed from the orbiter.

The experiments are primarily designed to demonstrate the feasibility of using space-based, electro-optical and laser systems for the acquisition, subsequent tracking, and marking of missiles from space. Some of the proposed experiments use the electro-optical system in a passive fashion, while others use it in a mix of active and passive modes. A passive experiment uses the electro-optical system cameras to capture images with available light (e.g., the calibration and background experiment described in Sect. 2.1.3.1). An active segment of an experiment uses lasers to provide the necessary illumination [e.g., acquiring and tracking a ground launched Starbird vehicle and its plume (Sect. 2.1.3.4)]. Approximately 20 separate events or engagements are scheduled for Starlab as parts of six experiments.

Figure 2-2 shows a typical earth orbital path for the orbiter and indicates the ground sites involved in the experiments. These sites include Wake Island, Cape Canaveral, and the Hawaiian Island of Maui, as well as Antigua and Ascension Island, which are to be evaluated in separate documents (Sect. 1.2).

2.1.1 General Description of the Starlab

Figure 2-1 shows the orbiter with its bay doors open and the experimental Starlab payload exposed. The major components of the payload (Fig. 2-3) include the Spacelab module and the Spacelab pallet. As shown in Fig. 2-3, the Spacelab module, located forward of the pallet, is accessed by the crew via an umbilical connection (i.e., egress tunnel). Primary tasks of the payload specialists include observing and evaluating the Starlab experiments and being ready to correct problems with the equipment should they arise. In this capacity, the specialist will serve as systems safety officer by having the ability to shut down any experiment or modify experimental operating parameters. The specialist will observe and control the experiments through devices contained in the experiment control racks (Fig. 2-3).

The module will contain the optical bench that houses the marker laser and associated electronics (Fig. 2-3). The marker laser will be used to mark experimental objects once they have been identified and are being tracked. The Spacelab module and pallet are electro-optically linked and will function in a coordinated fashion during the experiments, with the marker beam traveling through the optical viewpoint into the Spacelab pallet.

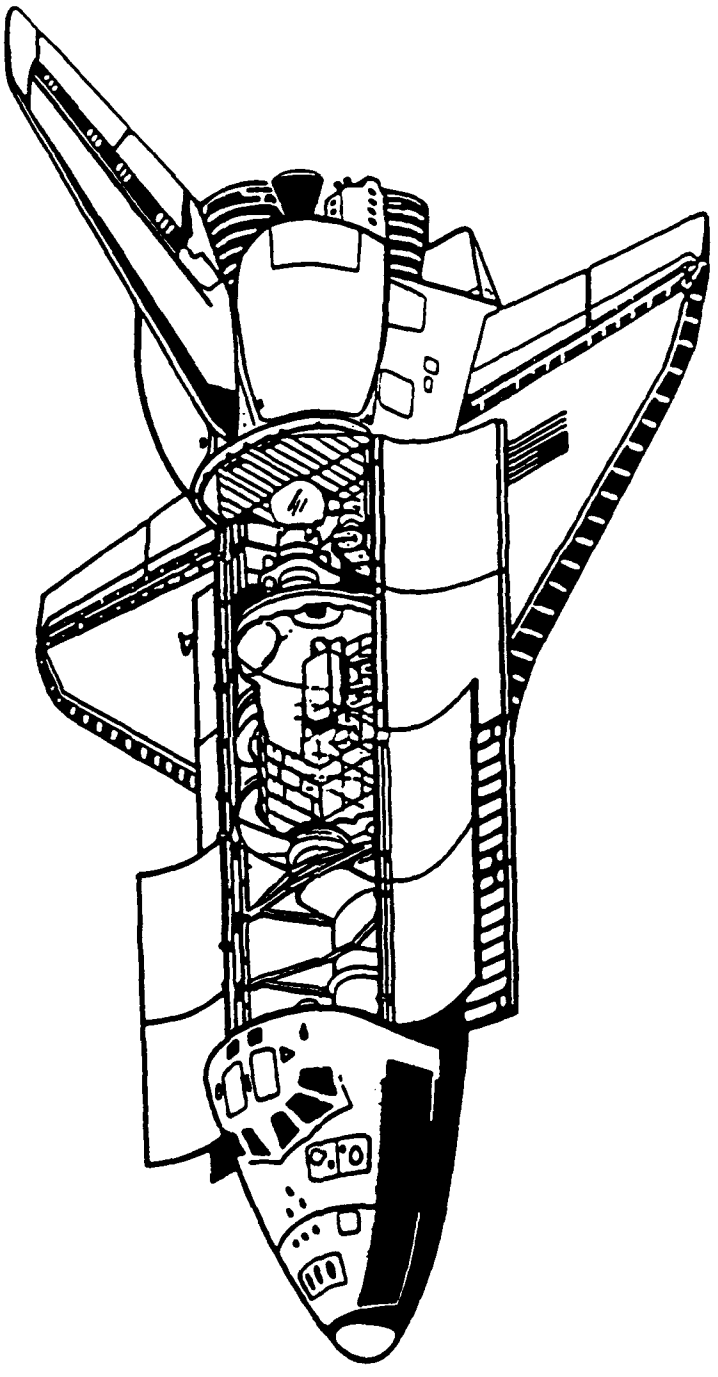

Fig. 2-1. The Space Shuttle (Orbiter).

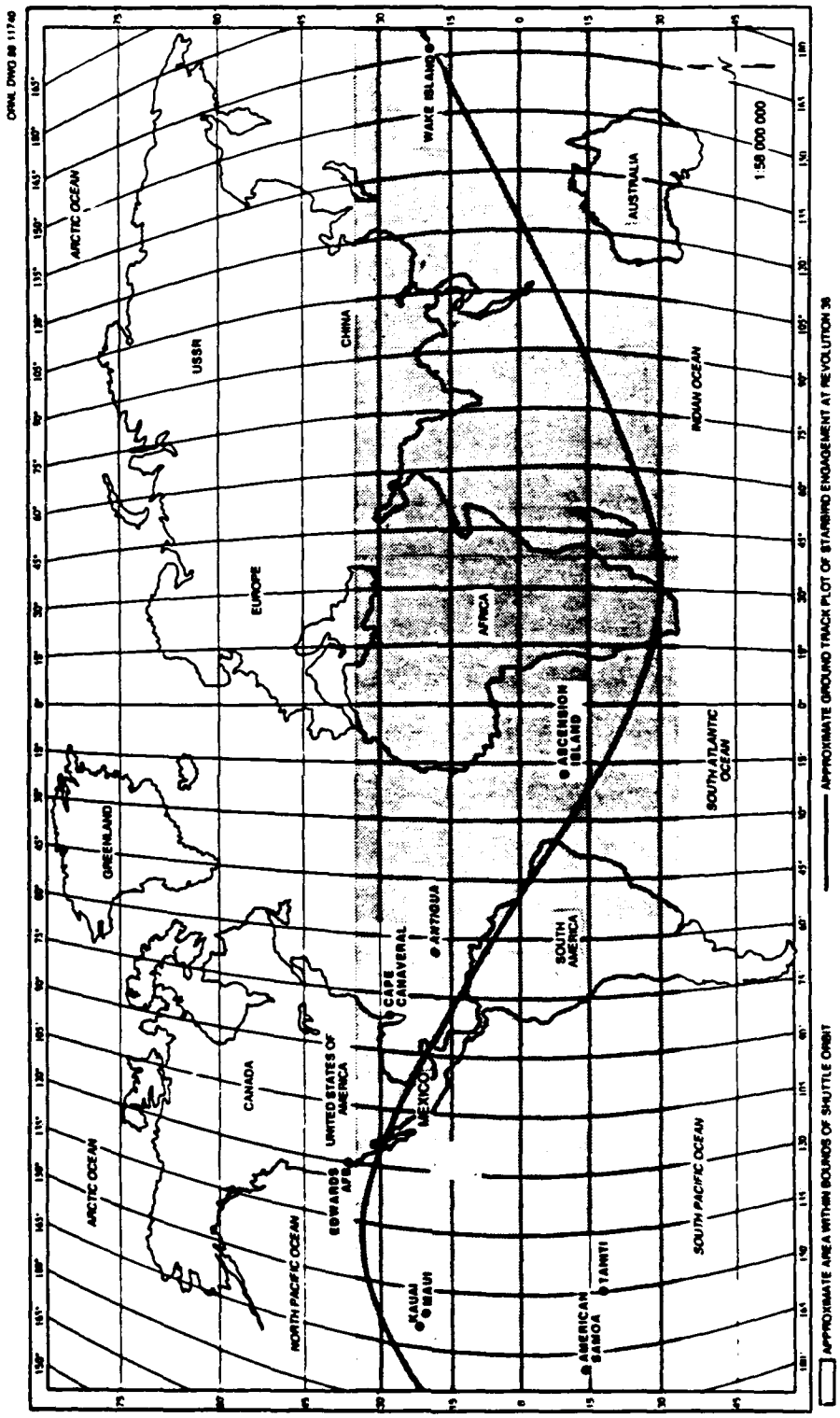

Fig. 2-2. Typical orbit and Starlab ground sites.

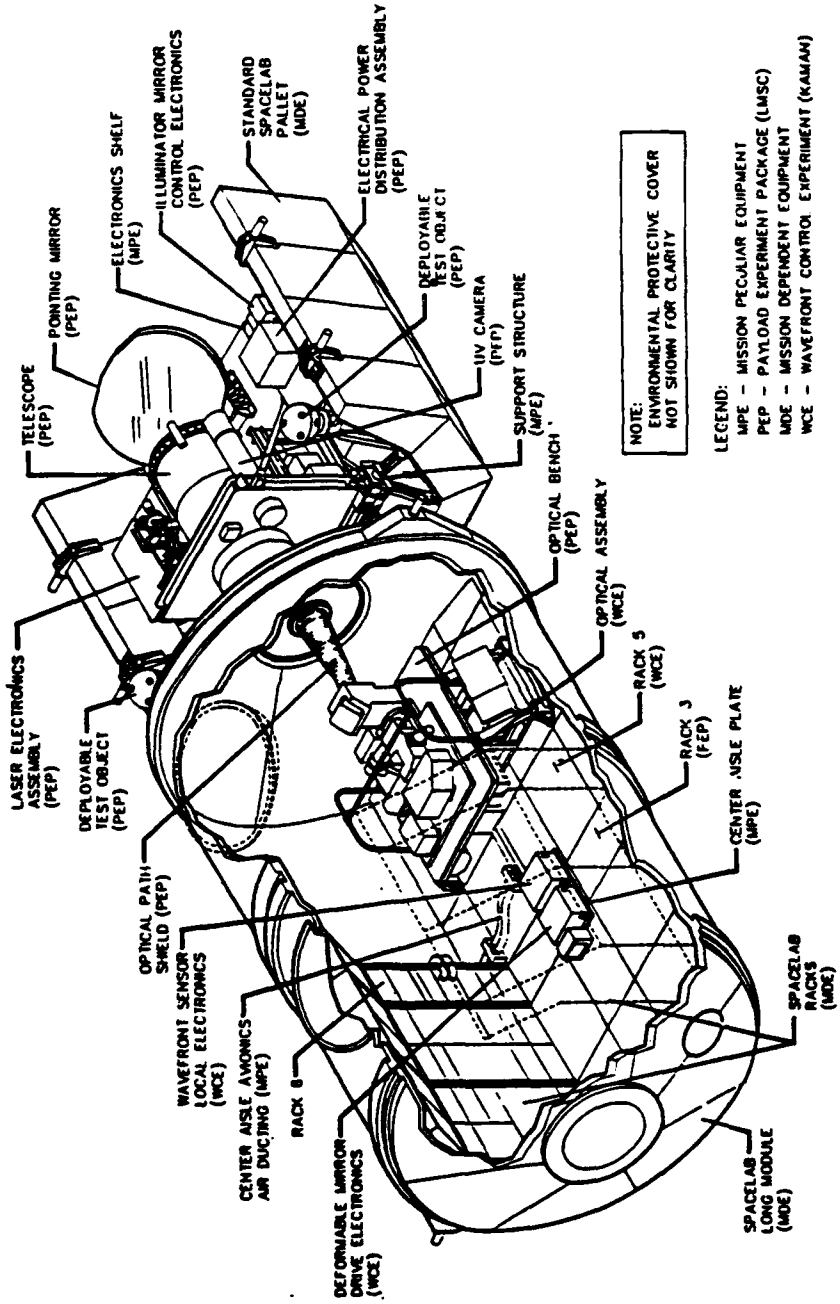

Fig. 2-3. The Starlab payload.

Major elements contained within the Spacelab pallet (Fig. 2-3) will be the illuminator laser; a 31.5-in. (80-cm) telescope; ultraviolet, acquisition video, and infrared cameras; a 5-ft (1.5-m) pointing mirror; and STOs. The Spacelab pallet will be open to space. The marker laser beam passes through the optical viewpoint, is routed through the telescope, and is subsequently reflected by the pointing mirror to its destination. All other optical beams and images are reflected by the pointing mirror. The cameras are used for initial acquisition and during the passive portions of experiments to assist in identifying experimental test objects under a variety of conditions. The illuminator laser will be used in an active mode to illuminate and track experimental objects. The retroreflector, located on the forward bulkhead, will return a laser beam originating at AMOS to its source as part of the SWAT experiment (Sect. 2.1.3.5). The STOs, which are 18.5-in. (47-cm) diameter spheres, will be deployed as described in Sect. 2.1.3.2.

The two types of lasers that will be transmitted from the orbiter are the "marker" (red) and "illuminator" (green) lasers. A back-up to the illuminator laser will be provided. The SWAT experiment described in Sect. 2.1.3.5 will involve two ground-based lasers, a beacon (blue) and an uplink (green) laser, located at AMOS. The Starlab marker laser beam (red) will be modulated with data and pointed at AMOS to convey uplink beam characterization. Some general characteristics of these four lasers are given in Table 2-1, and a more detailed technical description is provided in Appendix E.

2.1.2 Ground Operations

Ground operations include (1) experiment command, control, and configuration; (2) experiment performance assessment; (3) data analyses; and (4) dedicated planning. Operations during the mission will be controlled from and coordinated with the NASA Marshall Space Flight facility at Huntsville, Alabama. Ground control facilities will be located at Cape Canaveral and Wake Island for the Starbird engagements and at Maui for the SWAT experiment. These control facilities will be in continuous communication with NASA throughout the 7-day mission. Additional discussion of ground operations is provided in the following descriptions of individual experiments.

2.1.3 Starlab Experiments

The experiments and engagements included in the proposed action (Table 2-2) can be grouped for discussion as passive and active experiments. Passive experiments do not involve lasers and are used to gather background data and calibrate equipment. Active experiments use lasers and include the Space Test Objects/Rapid Retargeting experiment, the Ground Calibration engagements, the Starbird engagement, and the SWAT experiment.

Table 2-1. Characteristics of lasers to be used in Starlab experiments[a]

Characteristic	On the shuttle		At Maui[b]	
	Illuminator	Marker	Beacon	Uplink
Wavelength	0.5321 μm	0.6328 μm	0.4880 μm	0.5145 μm
Color	green	red	blue	green
Beam energy (at laser aperture)	220 mJ/pulse	<5 mW	4 W	5 mW
Mode of operation	pulsed	continuous	continuous	continuous
Maximum permissible exposure to the eye[c]	3.34×10^{-7} J/cm^2	6.36×10^{-4} J/cm^2 (for 0.25 sec)	6.36×10^{-4} J/cm^2 (for 0.25 sec)	6.36×10^{-4} J/cm^2 (for 0.25 sec)

[a]Table E-1 (Appendix E) presents more detailed information on laser characteristics.
[b]Maui is the location of the Air Force Maui Optical Station (AMOS), the ground location for the Short Wave Adaptive Technology (SWAT) experiments.
[c]International Radiation Protection Association (1985).

Table 2-2. Summary of proposed Starlab experiments/engagements

Experiment/engagement	Ground location(s)	Action(s)
Background experiment	Non-specific	Collect and analyze ultraviolet and and infrared data by passively scanning the earth's surface.
Planets and stars background experiment	None	Passively observe the stars and planets from the orbiter to calibrate the electro-optical system.
Space test objects and rapid retargeting experiment	None	Boresight the illuminator laser to the marker laser; demonstrate ability to change from tracking one STO to acquiring and tracking a second STO.
Ground calibration engagements	1. Ascension Island 2. Antigua	Locate and actively scan sites with red and green lasers, which are then reflected back to the orbiter.
Starbird engagements	1. Wake Island, Peacock Point 2. Cape Canaveral, Launch Complex 20	Actively identify and track Starbird vehicles and plumes from the orbiter using green and red lasers.
Short Wave Adaptive Technology experiment	Air Force Maui Optical Station (AMOS)	Actively link the orbiter and AMOS with blue and green lasers from AMOS and a red laser from the orbiter.

2.1.3.1 Passive experiments

Several experiments are designed to collect data and/or calibrate Starlab equipment without using lasers. Star calibrations are required to update the Starlab gyros and to calibrate the electro-optical system. Gyro updates are performed as required throughout the mission. Star calibrations are performed initially and prior to each experiment that requires accurate pointing. Observations of planets are used to provide extended sources for wavefront control experiments, in which measurements are made on vibration effects so that data can be corrected during later analyses. Earth background experiments are designed to obtain data by passively scanning the earth's surface and collecting ultraviolet and infrared radiation data. Plume phenomenology experiments are designed to use Starlab's ultraviolet and infrared sensors to collect data on the characteristics and physical behavior of plumes from Starbird vehicles launched from Cape Canaveral and Wake Island (Sect 2.1.3.4).

2.1.3.2 Space Test Objects and Retargeting Experiments

Two small STOs (Fig. 2-4) are deployed from the orbiter and used in several experiments. The STOs weigh approximately 150 lbs (68 kg). They have diffuse white coatings to enhance passive observation and return of the tracking illuminator laser beams directed at them. Retroreflectors on the STOs return the marker laser beam to the Spacelab.

A single STO is used for boresighting the illuminator laser to the marker laser. Scoring accuracy on the STOs can be evaluated during the experiments. In a separate experiment, two STOs are used to demonstrate the capability of rapidly changing from tracking one object to acquiring and tracking a second.

2.1.3.3 Ground Calibration Engagements

Ground calibration sites will be established so that the orbiting Starlab can calibrate its optical control system in flight prior to subsequent Starbird engagements involving the launching of vehicles from Cape Canaveral and Wake Island (Sect. 2.1.3.4). The two ground calibration sites that were selected are on Antigua and Ascension Island. As noted in Sect. 1.2, these sites are evaluated in separate documents.

2.1.3.4 Starbird engagements

The USASDC has prepared sites at Cape Canaveral Air Force Station (CCAFS) in Florida and at Wake Island in the North Pacific (near the Marshall Islands) for launching Starbird vehicles. Six Starbird vehicles will be available for Starlab engagements, and a seventh will be used for a developmental launch from CCAFS to test the target vehicle prior to the Starlab mission. At each site, a maximum of three vehicles will be launched on a ballistic trajectory to

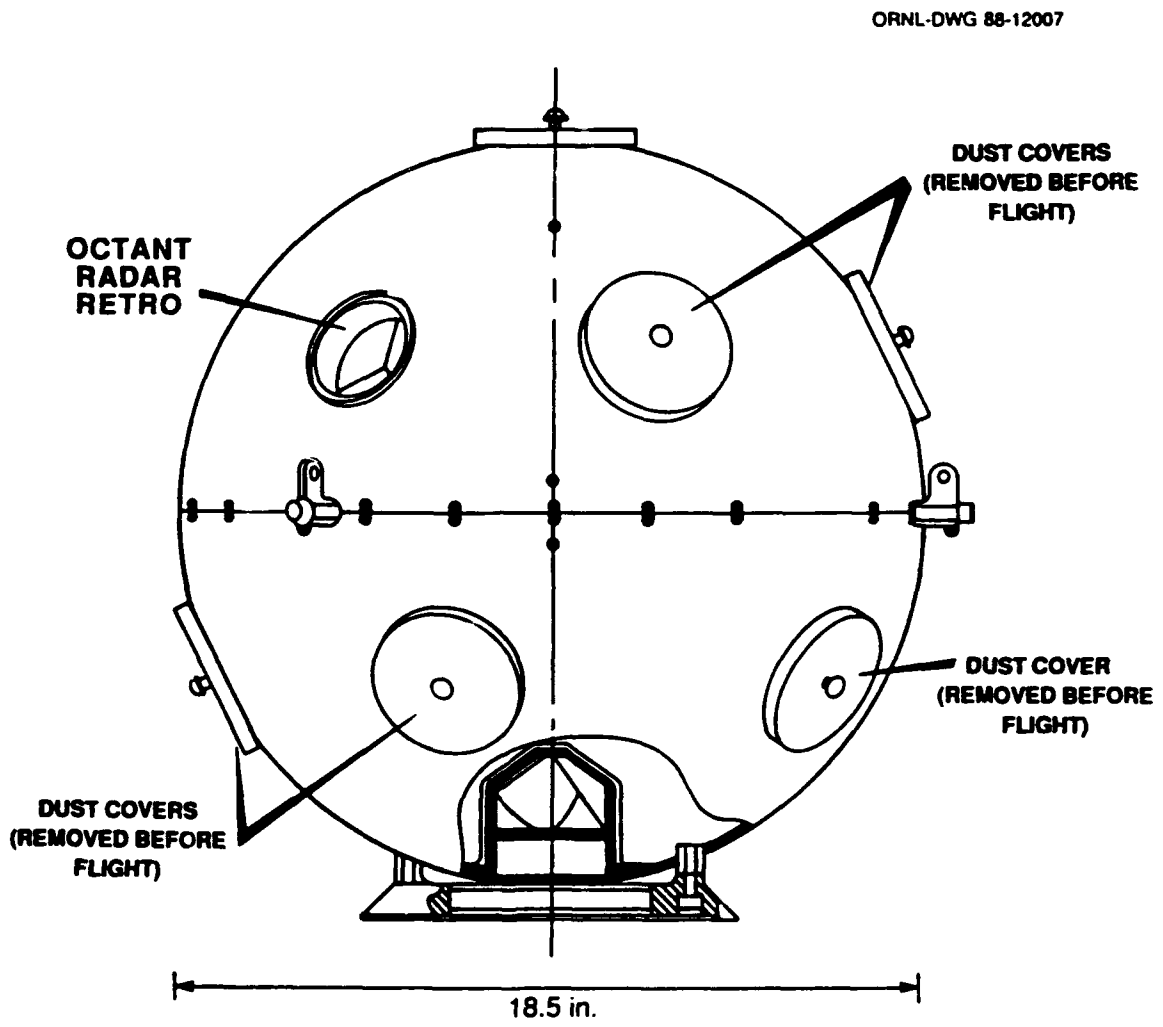

Fig. 2-4. Starlab space test object.

allow the Starlab to acquire and track the Starbird plume and hardbody (the body of the launch vehicle) through a series of events in the flight.

The Starbird launch sites are located at Peacock Point on Wake Island (Fig. 2-5) and LC 20 at CCAFS (Figs. 2-6 and 2-7). A description of the Starbird launch sites is given in the EA prepared by the U.S. Army (1987). Changes in project plans at Wake Island since the EA was written include the following: (1) the wind tower, security fencing, two guardhouses, a pyrotechnic storage building, and a small launch pad have been deleted; (2) an additional site investigation revealed the presence of asbestos in Building 1644 that was subsequently removed and disposed of off Wake Island in compliance with EPA regulations (40 CFR Part 61); and (3) an area for the Mobile Real Time System (MRTS) range safety vans, one mobile radar site and one mobile telemetry site on Wilkes Island, and one mobile radar site approximately 200 ft (60 m) north of the MRTS site have been added. Changes in project plans at CCFAS since the Starbird EA was written include the following: (1) plans to build a new missile assembly building (MAB) were deleted; (2) an existing missile assembly building (MAB No. 3, Pershing Program) will be used; (3) the meteorological tower was deleted; and (4) a MRTS team would be present on the site in a passive role (i.e., they would not be active participants in the launches).

The facilities and operations at the two Starbird launch sites will be essentially identical. Each site contains two launch pads, approximately 25 ft^2 (2.3 m^2) with 50-× 80-ft (15- × 24-m) work aprons, a launch equipment building, a payload assembly building, a launch operation control center, and mobile ground support equipment. At Wake Island site, existing buildings are being modernized to use for missile assembly, motor storage, and the launch control center. The Wake Island facilities include a mobile range tracking support system transported by air from White Sands Missile Range, New Mexico. Construction of the Wake Island facilities, involving a work force of approximately 60 persons, has been completed. Limited site preparation work is required for the mobile equipment. Approximately 120 additional personnel will be required at Wake Island during the pre-operational and operational phases of the Starbird engagements (a 90 to 120 day period).

Modernizing the blockhouse and payload assembly buildings at CCAFS and the construction of two launch pads at LC 20 has been completed. About 25 additional personnel will be added to the work force at CCAFS during the preoperational and operational phases of the Starbird engagements and for the preliminary development launch prior to the Starlab mission.

The Starbird launch vehicle is shown in Fig. 2-8. The Starbird payload that is covered by a protective shroud is a "scoreboard" laser target that is used to collect data for evaluating the engagement. The launch vehicle consists of four stages and measures approximately 57 ft (17 m) in length. The total weight of the vehicle is about 8 tons (7250 kg). The first stage will fall in the ocean, approximately 1 mile (1.6 km) from the launch site (U.S. Army 1987).

For each engagement with Starlab, two Starbird vehicles will be readied for launch at each of the sites, but only one will actually be launched. The second Starbird will be launched in the event of a technical problem with the first vehicle. If it is not required on the first shuttle engagement, the second Starbird from each site will be launched during subsequent shuttle passes.

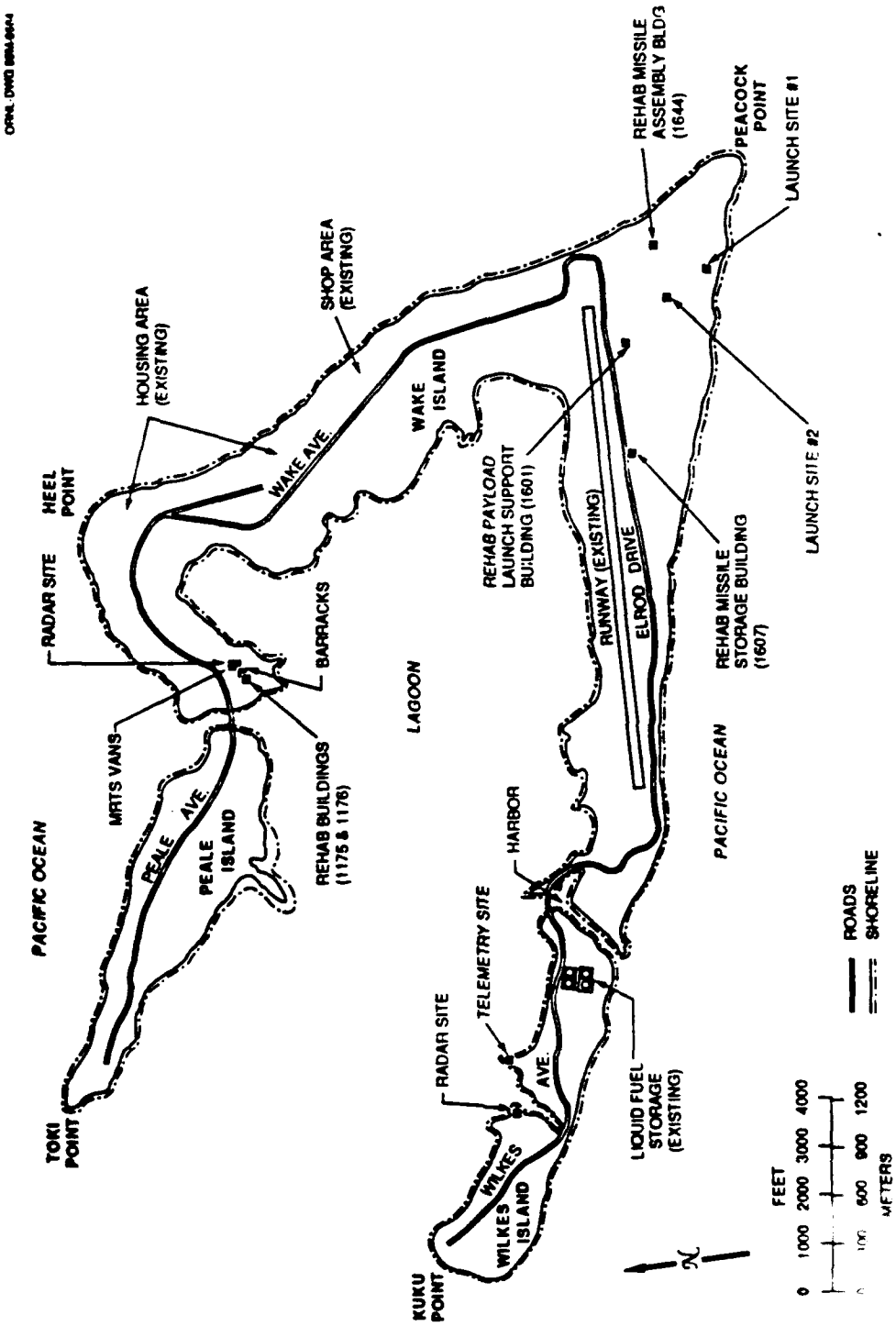

Fig. 2-5. Starbird launch sites on Wake Island.

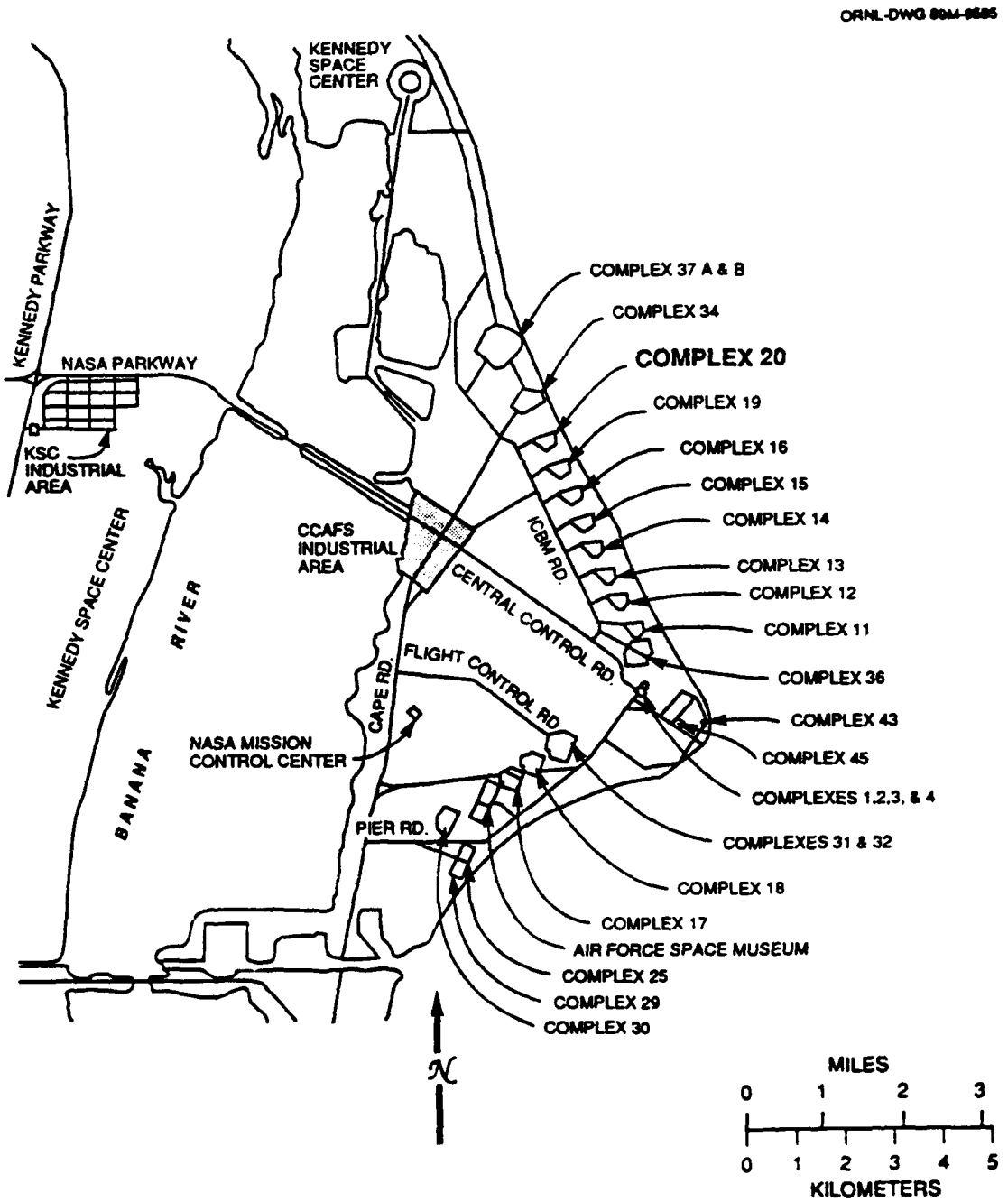

Fig. 2-6. Location of Launch Complex 20 at Cape Canaveral Air Force Station, Florida.

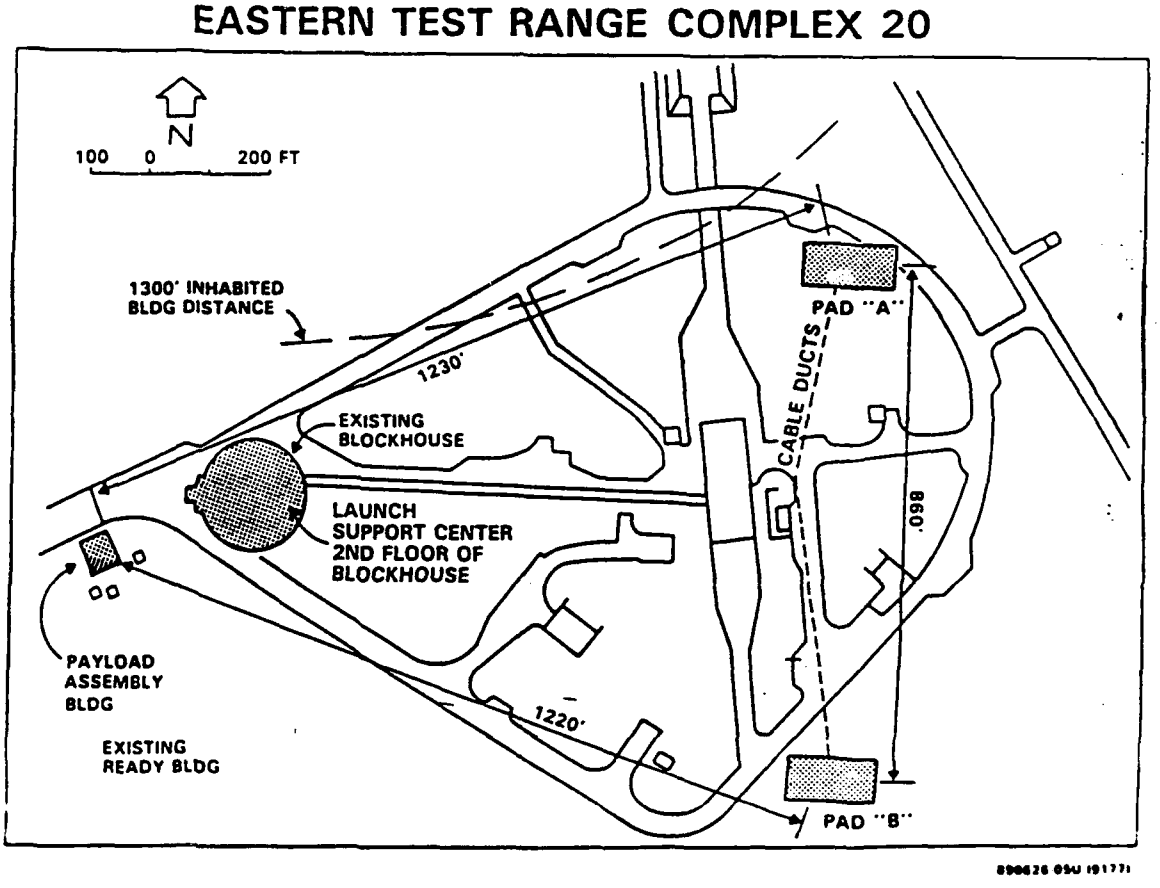

Fig. 2-7. Site layout at Launch Complex 20.

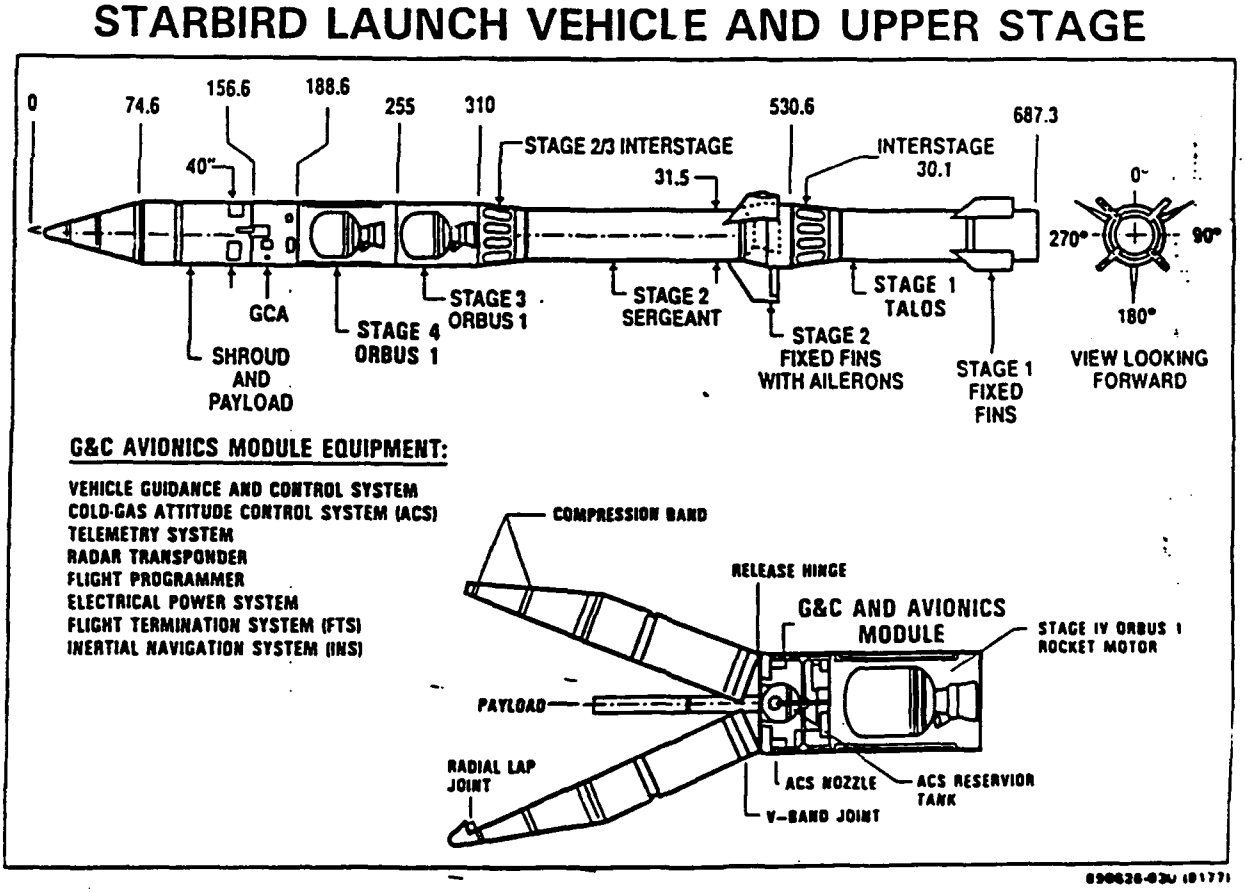

Fig. 2-8. Starbird launch vehicle. (Source: USASDC)

Each Starbird will be launched at a predetermined time as the orbiter approaches and the launch site comes within the Starlab field of view. A high intensity (at least 3000 W/sr) 6° x 10° beam aimed at a point on the horizon where the shuttle will appear is required to aid the crew in quickly locating the launch site. This light will be on for only 15 min and will be turned off 5 s before launch. When the Starbird vehicle is launched, Starlab will acquire the image of the Starbird plume through the use of either the video camera during day launches or the infrared sensor during night launches. The flight computer, using the video tracker signal processors (VTSP), will then acquire the plume. The payload specialist will verify that the plume has been properly acquired and that the experiment is on track. Once this check takes place, the system will automatically transfer the image of the plume to the visible coarse tracker of the infrared sensor. Data from the coarse tracker will be fed to the VTSP to calculate a plume centroid, which is used to control the large pointing mirror. Each Starbird engagement will last approximately 3.75 min.

The next task for the Starlab will be to acquire and track the protective shroud (the hardbody) of the Starbird vehicle. The shroud position, relative to the plume, will be calculated by a computer using a predetermined plume centroid-to-shroud distance and the range from the orbiter to the Starbird. The illuminator laser will then be pointed at the calculated position of the shroud and activated before burnout of the second stage of the Starbird. Tracking control will then be transferred from the plume imaging to the illuminated shroud once it has been imaged and acquired on the fine tracker camera. The shroud will then be ejected, exposing the scoreboard. The Starlab marker laser will next be pointed at the scoreboard, where detectors on the scoreboard receive the signal and use it to determine the accuracy and stability of the marker aimpoint. Self-scoring of the accuracy and jitter of the laser aimpoint will be accomplished by a retroreflector located in the center of the scoreboard. The retroreflector will return some of the marker laser to a detector in the Starlab electro-optical system through the pointing mirror and telescope.

2.1.3.5 Short Wave Adaptive Technology

The orbiting Starlab will participate in a SWAT laser experiment developed at AMOS in Hawaii (Fig. 2-9). The purpose of the SWAT experiment is to determine corrections to laser beams that are being distorted when travelling through the earth's atmosphere. This experiment involves a mirror at AMOS and employs three laser beams, two that originate from equipment at AMOS pointed at Starlab, and one from Starlab pointed at AMOS. Initially, a blue laser beam from AMOS will be pointed toward a reflector on Starlab. The reflected signal will be returned to AMOS and used to calculate the amount of distortion in the laser beam resulting from atmospheric influences. This information will be used to correct equipment settings. Next, a green laser will be directed at Starlab from AMOS. Starlab will acquire and track this green laser beam and measure "corrected" green beam characteristics. The information on the quality of the green beam will be transmitted over a red beam transmitted from Starlab back to AMOS. Additional technical information on this experiment is provided in Appendix E. The AMOS

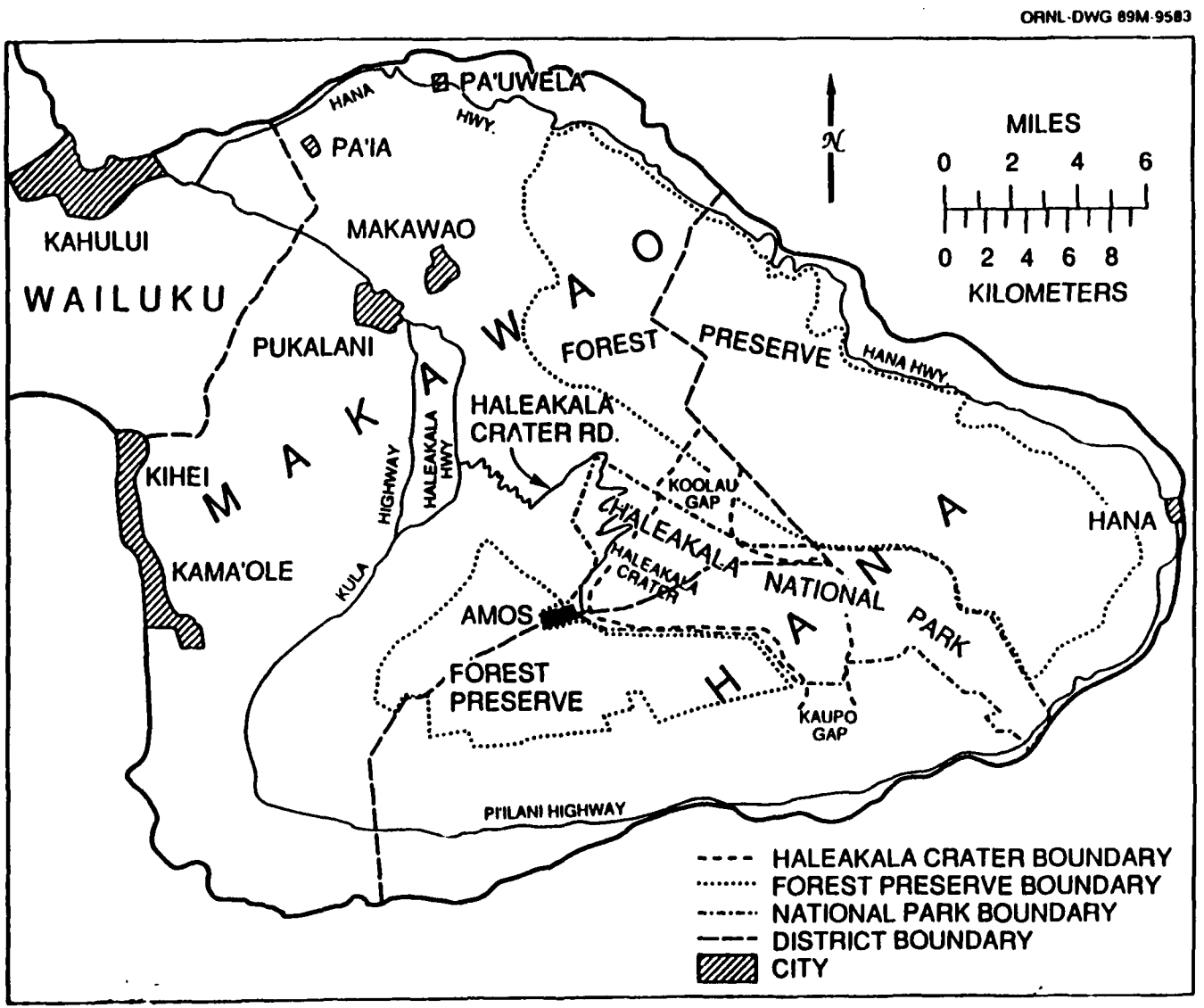

Fig. 2-9. Air Force Maui Optical Station (AMOS) site on Maui, Hawaii.

facility has been used successfully for tests known as the Adaptive Control Experiment, which involved identical laser engagements with high-flying aircraft.

2.1.4 Mitigation Measures

The proposed action includes the following mitigation measures to ensure that no significant impacts would occur:

1. Mitigation described in the Starbird EA (U.S. Army 1987) will be implemented.
2. USASDC will implement a program to educate all personnel working on or visiting Wake Island Atoll not to harm or harass any sea turtles found in near-shore waters.
3. USASDC will implement the Light Management Plan approved by the USFWS at CCAFS to ensure that sea turtles are not disturbed during Starbird launch activities.

2.2 ALTERNATIVES TO THE PROPOSED ACTION

This section discusses the no-action alternative and alternatives to the proposed action, focusing on alternative ground locations where impacts could occur.

2.2.1 No-Action Alternative

Under the no-action alternative, the Starlab experiments would not be conducted. The no-action alternative would not satisfy the DOD need for research and experimentation to support the SDI program. If the Starlab program were not implemented, no environmental impacts would result from the proposed action, but Starlab program requirements and scientific objectives would not be achieved.

2.2.2 Alternative Ground Locations

A number of potential sites were identified by the USAF when considering the objectives of the Starlab program. Screening of site locations was first done on the basis of technical criteria. Environmental considerations were factored into the process during the selection of specific locations. To meet the maximum number of scientific objectives, the site selection process was governed by three primary technical factors: (1) orbit criteria, (2) experiment function and scheduling, and (3) geographic location. Orbit criteria were determined by meeting the launch and landing restrictions, orbit ephemeris (i.e., known position of a body at regular intervals), and the desired timing for various experiments. Meeting the objectives of the

experiments ensures that the maximum amount of scientific information would be obtained from each activity. Specific geographic sites were selected because they fell within the view of the Starlab (Fig. 2-2) and because they could be used on repeat orbits to collect additional data and provide data replication. Application of these technical criteria resulted in the identification of four potential locations for ground calibration sites; namely, Roi Namur, Maui, Antigua, and Ascension Island.

Alternative locations for Starbird launch sites are discussed in Sect. 3.1 of the Starbird EA. The SWAT experiment was restricted to the Maui site because of the existing facilities and equipment at AMOS.

3. AFFECTED ENVIRONMENT

3.1 INTRODUCTION

This section describes the environment that could be affected by the proposed action. The resources that are evaluated include land use, terrestrial and aquatic ecological resources, threatened and endangered species, and cultural resources. A general description of other resources (e.g., air quality) is given as needed to provide adequate background for understanding the evaluation of impacts in Sect. 4 of this EA. A more detailed description of the affected environment for the Starbird launch sites at Cape Canaveral and Wake Island is provided in the Starbird EA (U.S. Army 1987).

3.2 STARBIRD ENGAGEMENTS

Descriptions of the existing environment at Wake Island Atoll and CCAFS is provided in Sects. 3.3 and 4.3 of the Starbird EA (U.S. Army 1987). The following sections summarize and update the information presented in that EA.

3.2.1 Wake Island

3.2.1.1 Physical setting

Wake Island is a coral atoll, located midway between Guam and Hawaii at 19° 18' N Latitude and 166° 38' E Longitude. The atoll consists of three smaller islands (Wilkes Island, Wake Island, and Peale Island), which together form the "V-shaped" atoll (Fig. 2-5). The islands are joined by causeways or bridges and surround a shallow lagoon. Wake Island Atoll is about 4.5-miles (7.2-km) long and 2.0-mile (3.2-km) wide with a total area of approximately 2600 acres (1050 ha). A bank reef completely circles the islands and varies in width from 30 to 1100 yds (27 to 1010 m). Water crosses the western reef to enter a lagoon, which has an area of 3.75 sq miles (970 ha). The shoreline of the atoll is 21 miles (34 km) long. Beaches surround the three islands and range in width from 20 to 170 yds (18 to 155 m).

3.2.1.2 Land use

Wake Island proper is the largest of the three islets with a 150 x 9850 ft (46 x 3000 m) runway, refueling and support facilities, administrative offices, and quarters for personnel. Air operations at Wake are normally conducted from 0800 to 1700 six days a week. Wake serves as a mid-Pacific emergency landing site for all aircraft; however, routine transient traffic must obtain permission from the USAF 15th Air Base Wing before utilizing Wake facilities. Electrical power to Wake is provided by diesel generators located on the northwest end of Wake Island proper.

Peale Island is uninhabited and devoid of infrastructure, except for an access road that traverses the island and ruins of the pre-World War II transpacific flying boat facilities and the

post-World War II Coast Guard facilities. Peale is an unofficial bird sanctuary for nesting seabirds in the region. Wilkes Island is the site of a liquid fuel storage area and an abandoned Federal Aviation Administration (FAA) navigational facility. Wilkes is also an important nesting site for seabirds.

3.2.1.3 Ecological resources

The vegetation on Wake and Wilkes islands consists of relatively few plant species. A description of species that were observed on the various Starbird sites during a recent survey by the USFWS is provided in Appendix A. Most of the sites have relatively similar habitats that are covered by shrubs and small trees interspersed with grass and bare ground. The proposed sites for the instrumentation vans, however, consist of grassy fields. The habitats on the sites appear to be typical of those that occur throughout Wake Island, and none appear to be unusual or unique. Some of the Wake Island sites and the two Wilkes Island sites have already been partially disturbed by previous projects, although the Wilkes Island sites are relatively undistrubed and have no existing structures. No wetlands are present on any of the sites (Appendix A).

Wake, Peale, and Wilkes islands provide nesting habitats for a variety of species of migratory seabirds (Table 3-1) that are widely distributed throughout the tropical Pacific (Pratt, Bruner, and Berrett 1987). Most of the nesting occurs on the relatively undisturbed Peale and Wilkes islands, but some occurs on Wake Island. During a recent USFWS survey, four species (red-footed booby, brown booby, masked booby, sooty tern) were observed nesting on Wilkes Island, but none were reported for Wake Island (Appendix A). Three sooty tern colonies, including a total of about 143,000 chicks, were present on Peale Island, and a colony of about 250,000 chicks was found at the west end of Wilkes Island. Smaller colonies of the other nesting species were also present at the west end of Wilkes Island and included 106 brown booby nests, two masked booby nests, and 41 red-footed booby nests (Appendix B). Nesting of these species was also observed immediately prior to the initiation of construction during a survey conducted by the U.S. Navy (Appendix D). Although several other species may nest sporadically at some of the proposed Starbird sites, most of which provide suitable nesting habitat, the two surveys found no evidence of recent nesting at any of the sites.

The red-tailed tropicbird appears to be the most widespread species on the islands and the most likely to occur on the sites. The nesting season for this species is not consistent from year to year and cannot be predicted. No nesting of this species was observed during the USFWS survey.

Several introduced animals that occur on the islands—including rats, numerous cats, and two dogs that roam the islands at will—prey on nesting birds and/or their eggs and, thus, reduce the populations of these birds. Although the extent to which predation by these animals limits the populations of seabirds is not known, it is a significant wildlife management concern because the birds (being located on oceanic islands) are not adapted to mammalian predators and could be severely affected.

Near-shore fishes are considered highly desirable for food and recreational purposes. Grouper (e.g., *Cephalepholis argus*), porgy (*Monotaxis graduculis*), jacks (*Caranjidae*), and sharks are abundant (Gooding 1971). No freshwater habitat occurs on Wake Island.

Table 3-1. Bird species at the various Starlab sites on Wake Island

Bird species[2]	Sites[1] MAB	MSB	Bar	PLS	La1	La2	PSB	Rad	Tel	G&M
Tree and shrub nesters										
Great frigatebird	x	x			x	x	x	x	x	
Red-footed booby	n	n			n	n	n	n		
Red-tailed tropicbird	x	x	x	x	x	x	x	x	x	
Black noddy	x	x			x	x	x	x		
White tern	x	x	x	x	x	x	x	x		
Grass and bare ground nesters										
Brown booby	n				n					
Masked booby	n	n			n					
Brown noddy					x				x	
Sooty tern	n	n			n			n	n	

[1]Sites: MAB = Missile Assembly Building (Bldg. 1644); MSB = Missile Storage Building (Bldg. 1606); Bar = Barracks (Bldgs. 1175 and 1176); PLS = Payload and Launch Support Building (Bldg. 1601); La1 = Launch Site 1; La2 = Launch site 2; PSB = Pyrotechnic Storage Building (Bldg. 1642); Rad = Radar site; Tel = Telemetry site; G&M = Guardhouse sites and MRTS site.

[2]No bird species were observed on the sites. The listed species are considered potential nesters on certain Wake Island sites, which were either not in their nesting seasons during the time of the survey (x) or were observed nesting on Peale and Wilke's islands and have not been reported to nest at the respective Wake Island site (n).

3.2.1.4 Threatened and endangered species

The green turtle (*Chelonia mydas*), a threatened species under the Endangered Species Act of 1973, has been observed in the vicinity of Wake Atoll and in the lagoon (G. H. Balazs, NMFS, Honolulu, letter to Colonel S. N. Liberatore, USASDC, Huntsville, Alabama, 1987). A recent survey by the NMFS indicates that, at the least, a small resident population exists and there is available forage for turtles on the reef faces (Appendix C). Although turtle nesting habitat is present on the island, no nesting is known to occur.

Marine mammals protected under the Marine Mammal Protection Act of 1972 that may be present in waters around Wake Island include the Pacific bottlenose dolphin *(Tursiops truncatus gilli,)*, Spinner dolphin *(Stenella longirostris)*, Cuvier's beaked whale *(Ziphius cavirostris)*, and the Hawaiian monk seal *(Monachus schauinslandi)* (Appendix C). The monk seal is also listed by the USFWS as an endangered species. No other threatened or endangered fishes, terrestrial plants, or animal species are known to occur on the islands.

3.2.1.5 Socioeconomic and cultural resources

Approximately 170 personnel are involved with Wake Island Air Station operations. The work force consists of approximately 7 USAF personnel, 20 U.S. citizens, and 143 Thai nationals, under contract to the USAF to provide base support. All persons on Wake Island are associated with the operations of the Air Station and live in USAF housing.

Wake Island has many structures abandoned in place since World War II when the Island was the site of battles between the United States and Japan. In 1985, Wake Island was designated a National Historic Landmark to preserve these resources (U.S. Army 1987). All Japanese structures and fortifications and American ammunition magazines are specifically called out as historic sites in the designation. Through an agreement with the Department of State, all Japanese remains were removed and returned to Japan.

3.2.2 Cape Canaveral

3.2.2.1 Physical setting

The LC 20 site is adjacent to the Atlantic Coast on CCAFS, Brevard County, Florida (Fig. 2-6), and has recently been renovated by the U.S. Army for the Starbird project. CCAFS occupies 15,800 acres (6400 ha), nearly the entire barrier island on which it is located. The primary function of CCAFS is to support DOD, NASA, and commercial users by providing launch, tracking, and other facilities.

The barrier island on which CCAFS is located comprises relict beach ridges (remnants of ancient beach structure formed by wind and waves) situated on a series of limestone formations several thousand feet thick. Soils are generally well-drained sandy soils mixed with shell fragments. Permeability is rapid, and the available water capacity is low. The soils are not suited for agricultural purposes because they have low organic-matter content and poor natural fertility.

The climate at CCAFS is strongly moderated by its coastal setting. Variations in temperature and atmospheric moisture content are relatively slight. Average daily maximum

temperatures range from 69°F (21°C) in January to 88°F (31°C) in July. Surface-based temperature inversions occur about 2% of the time. Relative humidity is usually between 70 and 100%. Average annual precipitation is 45 in. (114 cm), with the monthly maximum occurring in September and the monthly minimum occurring in April. A pattern of easterly sea breezes during the daytime and westerly land breezes at night is very common in the summer but less common in winter. Easterly winds are the most frequent, followed by winds from the east-southeast, southeast, and south-southeast.

Rainfall and surface runoff from impermeable surfaces at LC 20 percolate into the soil, and surface runoff over the site's soils generally does not occur. No wetlands, streams, or floodplains are present near the site. Near-surface drainage in some locations at CCAFS is collected by a series of man-made canals that drain into the Banana River.

Major inland water bodies near CCAFS are the Banana River (Fig. 2-6) and Indian River to the west and the Mosquito Lagoon to the north. These are shallow lagoons, except for the portions that are maintained as part of the Intracoastal Waterway between Jacksonville and Miami. Surface water quality at several monitoring stations in the Banana River near CCAFS is good. The waters of Merritt Island Wildlife Refuge, Sebastian Inlet State Recreational Area, Canaveral National Seashore, and the Banana River Aquatic Preserve are classified as Outstanding Florida Waters as part of the Florida Surface Water Criteria and, as such, are afforded the highest degree of protection by the Florida Department of Environmental Regulation. There are no freshwater bodies on the launch site itself.

3.2.2.2 Land use

The pattern of developed land use on CCAFS consists of launch complexes along the base's eastern edge, with supporting facilities located in the base's central and western portions (Fig. 2-6). The launch complexes are the main use of the developed land and, with their support facilities, occupy approximately 30% of the land area of CCAFS; the remaining area is undeveloped (USAF 1989). More than 40 complexes line CCAFS' eastern edge. Other facilities include an Industrial Area, the Air Force Space Museum, Trident and Poseidon submarine wharfs, NASA Mission Control, and a skid airstrip. Numerous hangars, located mostly on the western portion of CCAFS, are used for assembling and testing purposes. No major changes are foreseen in the pattern of land use on CCAFS.

3.2.2.3 Ecological resources

The predominant vegetation on CCAFS consists of coastal scrub and coastal strand (George 1987, USAF 1986). Wetlands on CCAFS include 20 acres (8 ha) of fresh water wetlands, 450 acres (180 ha) of mangrove swamp, and 140 acres (60 ha) of salt marsh (George 1987). Numerous wildlife species use the natural habitats provided by CCAFS (see USAF 1986). Various species of gulls, terns, sandpipers, other shorebirds, and endangered sea turtles (Sect. 3.2.2.4) use the beaches. Scrub habitats are inhabited by gopher tortoises, several species of snakes, and many species of birds and mammals. The LC 20 complex itself is inhabited by few wildlife species and does not provide significant habitat for wildlife other than the gopher tortoise,

which has burrows in the site's herbaceous habitat and is listed as a species of special concern in the state of Florida (FGFWFC 1988).

3.2.2.4 Threatened and endangered species

Threatened and endangered (T&E) species that may potentially occur at CCAFS are those that have been observed in Brevard County or on CCAFS itself, as listed in Table 3-2. Resident species that are known to occur or probably occur in the immediate vicinity of LC 20 include the indigo snake, kestrel, and scrub jay. Suitable year-round habitats or nesting habitats for the other species listed in Table 3-2 are not present, and there is little potential for these species to occur regularly near LC 20. The endangered West Indian manatee (*Trichechus manatus*) occurs in the Banana River, which is considered critical habitat for this mammal.

Beaches near the launch complex are prime nesting habitat for several T&E species of turtles including the loggerhead (*Caretta caretta*), green (*Chelonia mydas*), and hawksbill (*Eretmochleys imbritcata*). These turtles come on shore, mainly at night, to excavate nests in the sand above the high-tide line. Nesting occurs from April through September. Hatchlings emerge in 50–75 days and normally move to the ocean (Dodd 1988, Murphy 1987). Many, however, can apparently be confused by onshore lighting and move inland, thus experiencing increased mortality (Sect. 4.4.2.4).

3.2.2.5 Socioeconomic and cultural resources

A recent general socioeconomic profile of the Cape Canaveral complex is given in the EA for the Medium Launch Vehicle II (USAF 1989). Because of the small work force involved with the Starbird project, nc socioeconomic impacts are anticipated (Sect. 4.3.2.5).

Because the LC 20 site has been highly disturbed in the past, it is unlikely that any historic and archaeological resources remain (U.S. Army 1987). Consultation with the State Historic Preservation Officer required under the National Historic Preservation Act has been completed by USASDC (U.S. Army 1987 and Appendix G).

3.3 SHORT WAVE ADAPTIVE TECHNOLOGY EXPERIMENT

3.3.1 Physical Setting

The SWAT experiment will take place at AMOS, located in Maui County on the southwest rim of Haleakala Crater at the summit of Mount Haleakala, the younger of two shield volcanoes making up the island of Maui. The elevation at AMOS is approximately 10,000 ft (3050 m), with the highest elevation on Maui being 10,023 ft (3055 m) on Red Hill adjacent to AMOS. The land surface is comprised of a relatively barren desert of volcanic cinders with almost no vegetation.

Table 3-2. Threatened and endangered species in Brevard County and their status on Cape Canaveral Air Force Station (CCAFS)[1]

Species	Federal Status	State Status	CCAFS[2]
Loggerhead (sea turtle)	Threatened (T)	T	Occurs on beach
Green sea turtle	Endandered (E)	E	Occurs on beach
Hawksbill (sea turtle)	E	E	Not observed
Kemp's ridley (sea turtle)	E	E	Occurs on beach, no known nests
Leatherback (sea turtle)	E	E	Occurs on beach
Eastern indigo (indigo) snake	T	T	Resident
Atlantic salt marsh (Southern) water snake	T	T	Resident not observed
American alligator	T (similarity of appearance)		Resident
Rothchild's magnificent (Magnificent) frigate-bird		T	Transient
Wood stork	E	E	Visitor
Bald eagle	E	T	Visitor
Arctic peregrine (Peregrine) falcon	T	E	Transient
Southeastern American (American) kestrel		T	Visitor
Audubon's (crested) caracara	T	T	Visitor not observed

Table 3-2. (continued)

Species	Federal Status	State Status	CCAFS[2]
Florida sandhill (Sandhill) crane		T	Visitor not observed
Piping plover	T	T	Transient
Least tern		T	Nests on beaches
Roseate tern	T	T	Transient
Red-cockaded woodpecker	E	T	Visitor not observed
Florida scrub (scrub) jay	T	T	Resident
Kirtland's warbler	E	E	Transient not observed
Dusky seaside (seaside) sparrow	E	E	Probably extinct
West Indian manatee	E	T	Resident in waters
Southeastern beach (oldfield) mouse	T		Resident

[1]The species are listed in the order presented by Banks, McDiarmid, and Gardner (1987), to which the reader is referred to obtain scientific names. For those species whose common names as listed by the sources differ from those given by Banks, McDiarmid, and Gardner, the common names used by Banks, McDiarmid, and Gardner are indicated in parentheses.

[2]Resident indicates a species that occurs on CCAFS year-round; Visitor — a resident bird species that occurs on CCAFS but does not nest there; Transient — a bird species that occurs at CCAFS only during the season of migration; Resident, Visitor, or Transient not observed — a species that is a resident, visitor, or transient, respectively, in the Brevard County area but has not been observed on CCAFS, or for sea turtles, not observed during for the past five years.

Sources: FGFWFC (Florida Game and Fresh Water Fish Commission) 1988. Official Lists of Endangered and Potentially Endangered Fauna and Flora in Florida, GFC 88/9-022, Tallahassee, Fla.; George, D. H. 1987. Fish and Wildlife Management Plan for Cape Canveral Air Force Station, Florida, U.S. Air force, Cape Canaveral, Fla.; Pritchard, P. C. H., series ed. 1978. Rare and Endangered Biota of Florida, Vol. 1-4, Florida Game and Freshwater Fish Commission, University of Florida Press, Gainesville, Fla.; 50 CFR Pts. 17.11-17.12.

3.3.2 Land Use

The SWAT experiments would take place at the existing AMOS facilities that were constructed during the 1960s for the purpose of making optical measurements in the atmosphere. AMOS is part of a loose organization of buildings known as "Science City." Important sites at Science City in addition to AMOS include a repeater station for Aeronautical Radio, Inc., the Airglow Observatory, and the University of Hawaii Institute of Geophysics Solar Observatory. Three television repeaters, a USAF building, an FAA site, repeater stations for Maui and Hawaii County police radio, and Mt. Haleakala National Park Red Hill Overlook are located near Science City. The infrastructure, including electrical power supply, water, sewage treatment, and solid waste disposal is established and in place. Access is provided by West Crater Rim Road.

The AMOS facilities include several separate buildings. The University of Hawaii has a separate observatory building adjacent to the AMOS site. AMOS lies between Haleakala National Park to the northeast and east, privately-owned land to the north and northwest, and a forest preserve from the northwest to the southeast (Fig. 2-9). Forest preserves include primarily government-owned land, about one-fourth of which is leased for pasture and sugarcane. AMOS is surrounded by a designated conservation district in which land uses are governed by the State Department of Land and Natural Resources (University of Hawaii 1983).

3.3.3 Ecological resources

The AMOS complex is located in a high-altitude desert comprised of volcanic boulders, stones, coarse cinders, and small, widely spaced clumps of plants or individual plants. Plant cover is about 1%. At lower elevations, stunted shrubby vegetation is more abundant. Common native plant species near AMOS include the shrub nina (*Dubautia menzeisii*), the herb tetramolopium (*Tetramolopium humile*), and two species of grasses (*Deschampsi nubigena* and *Trisetum glomeratum*). In comparison, the total native flora of vascular plants of Hawaii comprise 1000 to 1500 species that evolved from less than 300 colonizing ancestors (Stone and Loope 1987). Various introduced species and a transplanted individual of the native silversword (*Argyroxiphium sandwicense* var. *macrocephalum*) are also located near the AMOS facilities (USAF 1988). No wetlands are located in the area.

The native vertebrate terrestrial fauna of Hawaii includes no reptile or amphibian species, only one mammal species (the Hawaiian hoary bat), and many bird species. In addition to migratory bird species and those native Hawaiian birds that also occur in other geographic areas, Hawaii has had about 110 endemic species or subspecies. Of these, about 40 became extinct after the islands were settled by Polynesians. Another 23 became extinct after the arrival of European man in 1778, and 28 more are now threatened with extinction (Berger 1987, HAS 1986, Univ. of Hawaii 1983, van Riper and van Riper 1982). The causes of extinction appear to have been the loss of lowland forests to agriculture, the introduction of avian malaria to which endemic birds were highly susceptible, and numerous other factors involving plant and animal introductions to the islands (Pratt et al. 1987, Sakai 1988, Scott et al. 1987, Stone and Loope 1987).

Endemic species or subspecies that occur near AMOS include the Hawaiian dark-rumped petrel (*Pterodroma phaeopygia sandwichensis*), the Hawaiian goose or nene (*Nesochen sandvicensis*), and the Hawaiian hoary bat (*Lasiurus cinereus semotus*) (Berger 1987, HAS 1986,

van Riper and van Riper 1982). However, because of its location in a barren desert at the summit of Mount Haleakala, the AMOS site does not provide good habitat for these species. Other endemic birds occur at lower elevations, primarily in forests. A variety of introduced animals also occur near AMOS, including chukar, roof rat, and mongoose. There is no aquatic habitat present at the AMOS site.

3.3.4 Threatened and Endangered Species

To obtain information on T&E species, consultation with the USFWS was initiated under Section 7 of the Endangered Species Act (Appendix G). The dark-rumped petrel, nene, and hoary bat populations in Hawaii are all listed by the USFWS as endangered (USFWS 1988a). Detailed discussions of the ecology of these species near AMOS were presented previously by the USAF (USAF 1988). The petrel numbered about 900 pairs in the early 1980's and, although it occurs on several islands, it is known to nest only on Mount Haleakala. The birds are present primarily from March through October and spend the remainder of the year at sea. Burrows in which the birds nest are at elevations ranging from 7000 ft (2130 m) to just over 9600 ft (2900 m), and most (77%) are located in three subcolonies along the inner crater wall of the west rim, 0.6 mi (1 km) northeast of AMOS at the closest point. Petrels fly to and from their nests only after dark. Young petrels fledge in October.

The nene inhabits lava flow habitats primarily above 4000 ft (1200 m) elevation on the islands of Hawaii and Maui. The native Maui population was extirpated prior to 1900 and has been reestablished through a captive breeding and reintroduction program. The birds are nonmigratory and are present year-round. Predation by mongoose and feral cats on eggs and young has been an important factor in limiting the populations of both the petrel and the nene.

The hoary bat resides primarily below elevations of 4000 ft (1200 m) on Kauai, Maui, and the island of Hawaii (van Riper and van Riper 1982). They roost singly in trees and do not form colonies.

3.3.5 Socioeconomic and Cultural Resources

The Science City research complex in which AMOS is located in a remote area immediately outside the Haleakala Crater Historic District. The area has been severely disturbed by past construction activity. An archaeological survey of the AMOS facility found no cultural resources (USAF 1987).

4. ENVIRONMENTAL CONSEQUENCES AND MITIGATION

4.1 INTRODUCTION

This section evaluates environmental impacts of the Starlab engagements and experiments that could occur if the proposed program were implemented and identifies mitigative measures that would be implemented to minimize or avoid significant impacts on the environment.

The environmental impacts associated with the Space Shuttle have been evaluated in separate NEPA documents prepared by NASA and the USAF (NASA 1978, USAF 1983). Potential environmental impacts analyzed in these documents include effects of (1) acidic deposition from the ground cloud formed by exhaust products from the rocket engines; (2) use of hypergolic fuels; (3) sonic booms during the ascent of the Space Shuttle; (4) release of water, hydrogen chloride, chlorine, and aluminum oxide into the stratosphere; (5) release of exhaust products on the ionosphere during maneuvers and entry; (6) medical and biological effects from the Space Shuttle's impact on the stratosphere, including effects on the ozone layer; and (7) catastrophic failure. The programmatic EIS on the Space Shuttle considers the impacts of launch rates up to 40 per year from the Kennedy Space Center. No additional analysis of environmental impacts is included in this EA because the programmatic documents cover the range of issues associated with the Space Shuttle activities and because the Starlab program does not involve new impacts that have not been previously considered.

No environmental impacts would occur as a result of passive experiments (Sect. 2.1.3.1) that did not involve lasers and were conducted in orbit to calibrate equipment and collect background information. In addition, no environmental impacts would be likely to result from the Space Test Objects/Rapid Retargeting experiments (Sect. 2.1.3.2) that would deploy STOs for boresighting and testing the lasers because the engagements would take place in orbit and the Starlab lasers would be pointed into deep space. At the end of the Starlab mission, the small satellites deployed for the STOs experiment would remain in orbit for approximately six months and would, therefore, contribute a very small increment to the accumulation of space debris for this short period of time. The STOs would eventually reenter the atmosphere, where they would most likely burn up. Even if part of the STOs would survive reentry, the chances of them impacting inhabited areas on land would be negligible. Therefore, no environmental impacts from these activities would be expected, and no additional discussion of them is included in this EA.

4.2 EFFECTS OF LASERS

4.2.1 Potential Human Health and Safety Concerns

For the purpose of this EA, safety concerns for lasers at AMOS and on the Starlab are confined to potential eye or skin injuries from exposure to laser radiation in excess of defined maximum permissible exposure (MPE) limits. Potentially, exposed persons may be on the ground,

at sea, or in aircraft. Two of the laser systems to be used in the experimental program are currently located at AMOS. The uses of and safety analyses for these two systems have undergone extensive study; these studies resulted in a conclusion that no significant impacts would occur for the planned experiments (USAF 1988).

To illustrate the type of analyses performed for the SWAT and RME and to facilitate the understanding of important points about Starlab laser illumination of the ground surface, simplified calculations are provided in Appendix F. The illuminator and marker lasers on Starlab are used as examples. These examples use basic trigonometric relationships in conjunction with safety guidelines and regulations [Air Force Occupational, Safety, and Health Standard (AFOSH) 161-10 (USAF 1980), ANSI (1986), and IRPA (1984)].

An examination of the general nature of laser hazards for laser systems that would be used in the Starlab experiment has been made (see Appendix F). The results suggest that, using generally accepted methods described in IRPA (1984), ANSI (1986), and AFOSH 161-10 (USAF 1980), laser hazards exist for humans in several situations. Because of safety systems and planning, however, no situation has been identified for which the unaided eye would experience an overexposure either at the earth's surface or in aircraft. For example, assuming an 8X light gathering power for a binocular that might be used to view the illuminator laser, a rectangular zone roughly 130 x 230 ft (40 x 70 m) centered on the calibration site target exceeds the ANSI MPE for the human eye. This target zone would be protected, however, with physical boundaries [i.e., a 6-ft (1.8-m) fence]. Thus, inadvertent intruders would be prohibited from entering the illumination zone. Higher power optical devices could be used just outside the target zone with a result in exceedences of appropriate standards. The outer boundary of the calibration sites, roughly 3000 x 7600 ft (900 x 2300 m), would be posted with temporary signs and road blocks to prevent unauthorized entrance. Thus, all persons who might attempt to enter the sites for naked eye or optically aided viewing would be prevented from so doing. Even with the most powerful devices available to the public, viewing the weak "edges" of the footprint outside of the calibration sites would not result in exposure of exceedence levels. Further, while the blue illuminator at AMOS would be more intense than the MPE, the laser beam would always be pointed more than 30° above the horizon, thereby precluding any actual exposure situation.

In the following sections on specific Starlab experiments, potential health and environmental effects are discussed further. Additional, specific discussions of potential laser hazards and incident scenarios are presented based on the material developed in Appendix F of this document and in detailed safety analyses prepared on the Starlab program [PEP-20 (LMSC 1989)].

Most human experience with light is with conventional light sources that radiate isotropically (i.e., in every direction) or in slightly focused beams (e.g., as in automobile headlights). For traditional beam sources, the light beam spreads out rather rapidly with distance. Hence, a person can be temporarily blinded by a high-beam car headlight even if the person is many feet from the center of the road. Laser light beams do not spread like these conventional light sources.

If a viewer (e.g., an amateur astronomer) is not directly in the "footprint" looking "up the beam," the beam is essentially invisible. The presence of the laser beam may be detected from

light scattered when it passes through air containing dust or moisture particles, as observed during laser light shows. With scattered light from these laser beams, one literally sees the path of the laser. The scattered light from the Starlab lasers would be so weak that, even with a high magnification, the intensity would be reduced by factors of thousands to millions from the actual footprint and no eye hazard could exist from this scattered light. Likewise, light potentially reflected from a variety of unintended surfaces (i.e., in the case of misalignment or other error) would be degraded in reflection. In any case, the rate of Starlab travel would dictate that no reflection could be viewed for more than one pulse of 25 nanoseconds and would, therefore, not result in any exceedence of the exposure guidelines.

A detailed accident analysis is contained in the Payload Hazard Report [PEP-20 (LMSC 1989)] entitled "Inadvertent Exposure of Public or Orbiting Satellites to Laser Radiation." The scenario for the calibration sites includes persons using binoculars and postulates three levels of failure. The probability of a person seeing one pulse was estimated to be about 1×10^{-9}. This level of failure is so small and the duration of exposure is so short that the hazard is considered negligible.

4.2.2 Potential Laser Effects on Wildlife

Wildlife could be exposed to a laser beam in three ways: (1) birds could fly through a beam aimed from the shuttle to earth, (2) birds could fly through a beam aimed from the earth to the shuttle, or (3) a beam from the shuttle could accidentally wander off the target or be misdirected to areas inhabitated by terrestrial or marine wildlife (e.g., nesting areas).

In the most serious case that would result in maximum potential effect, an animal would be within a stationary laser beam, look directly at the laser source with both eyes, and have both eyes in focus on the source (except in the case of birds that can look directly at an object with only one eye). In the most serious case for animals, a portion of the laser beam would be focused to a point on each eye's retinal fovea, which is the most important area of the retina for vision. When the light energy of the laser beam is focused to a point in this manner, the energy is concentrated, and damage due to thermal heating of the retina or a photochemical change in the retina is most likely to occur (in the same way that a magnifying glass can be used to focus light energy from the sun to produce a hot spot) (Swope 1969). Damage to the fovea for whatever reason could result in a severe visual handicap. If the eye is not focused on the laser source, the light energy will not be focused to a point on the retina but would be spread out over a larger area of the retina and would not be as likely to cause damage. Also, if the eye is pointed somewhere off to the side rather than directly at the source, any damage to the retina would be outside the fovea and would be less likely to produce severe visual handicap.

Many bird species (hawks, eagles, terns, and swallows) have two foveae in each eye—one central fovea for monocular vision and one lateral fovea believed to be important for binocular vision (Sillman 1973, Martin 1985). Because no bird can point both eyes directly at the same object, light rays from the object cannot fall on the central foveae of both eyes simultaneously, which prevents binocular vision. It is believed, however, that a bird's lateral foveae may be located such that light rays from a source may be focused on both simultaneously, thus allowing

binocular vision. If this belief is true, both lateral foveae could be damaged simultaneously by a powerful laser beam if the bird were within the beam looking with both eyes toward the beam source.

If a bird were to fly through a laser beam pointed from the shuttle to a target on the ground, it would be exposed to the beam probably for no more than 5 to 7 s (depending on the diameter of the beam and the speed at which the bird is flying). It is highly unlikely that the bird would be looking at the laser as it entered the beam because the laser light source on the shuttle (as well as a laser source at an earth-based station) could not be seen or detected prior to entering the beam. The laser light source itself could be seen only by a bird within the beam that is looking into the exit lens and deep into the apparatus where the laser is located. For a bird outside the laser beam on earth, no point of light due to operation of the laser would be visible on the shuttle. Once a bird is within the laser beam, some time would pass before the bird could detect and focus on the laser source. Therefore, the time of eye exposure would be less than the time it took for the bird to fly through the beam.

If a bird were to fly through a laser beam originating from a stationary point on earth, where the beam is very narrow (i.e., less than a few feet), it would pass through the beam very quickly. For example, a bird flying at 30 mph (48 kph) would pass through a 2-ft- (0.6-m-) wide beam in less than 0.05 s. Near the earth, the light energy from an earth-based laser would be in a narrow beam and would thus be more concentrated than at a great distance from earth, where the beam would be more spread out; thus an earth-based laser would be relatively dangerous for a bird to view. As stated above, the bird would not be able to detect the laser source until it was essentially already in the beam. Because the beam would be so narrow, it is highly unlikely that a bird could detect and view or focus on the laser source in the very short time during which the bird would fly through the beam. Atmospheric scattering of light along the laser beam might allow a bird to detect the beam from some distance. The bird, however, would still not be able to detect the laser source until it flew into the beam.

An accidentally misdirected laser beam from the shuttle would have virtually no potential for impact on any moving or stationary individual animal, either on land or in the sea. The light energy would be reduced (i.e., less concentrated) and would be less able to cause injury because the beam's width would increase as it approached the earth's surface. For example, the beam from the red marker laser used in the SWAT experiment would be at least four orders of magnitude below the MPE of 2.5 mW/cm^2 and would have no adverse effect on any exposed animal, either moving or resting. The reflected beam from the blue laser in the SWAT experiment would be even less powerful than the marker laser and no impact would, therefore, be expected. Exposure to the beam would be extremely short due to the rapidity with which the beam would swing past the animal or would be shut off. There would be virtually no opportunity for the animal to look directly at the beam and focus its eyes on the laser.

Although the sensitivity of birds' eyes to bright light is not known, the literature indicates that the visual physiology of birds is generally not greatly different from that of humans. For example, maximum image brightness on the retina is very similar in the diurnal pigeon, the nocturnal Tawny owl, humans, and other mammals, and varies by little more than sixfold across a wide range of other nocturnal and diurnal vertebrate species (Martin 1985). Thus, optical

functions (as opposed to cell functions) of the avian eye are apparently incapable of gathering and focusing light energy to a significantly greater degree than those of the human eye, and the avian retina would not be subjected to significantly greater concentration of light energy and thermal heating. The remaining question is whether the cells and structures of the avian eye are more susceptible to photochemical damage than those of the human eye (i.e., damage caused by chemical changes due to bright light rather than thermal effects). Although information to answer this question is lacking, available literature shows no reason to expect that avian cells involved in vision are much more sensitive than those of humans.

Evaluation of eye damage to a human viewing a shuttle laser source from within the beam indicates that such damage could occur only if binoculars were being used to look directly up the beam towards the source (Sect. 4.2.1). The objective lenses of the binoculars are larger than the eye's pupil and, therefore, collect a much greater amount of light energy than the unaided eye, thus presenting greater potential for eye damage. Without the binocular light-gathering effect, it is considered highly unlikely that any damage could occur to the eyes of humans, other mammals, or birds exposed to a laser beam from Starlab.

4.3 IMPACTS OF STARBIRD ENGAGEMENTS

Sections 3.4 and 4.4 of the Starbird EA (U.S. Army 1987) address the environmental impacts of the Starbird project at Wake Island and at LC 20 at CCAFS, respectively. Changes that have occurred in these plans since the Starbird EA was written are described in Sect. 2.1.3.4. Sections 3.5 and 4.5 of the Starbird EA describe the enforcement and monitoring measures to accomplish the Starbird mission successfully. Construction at Wake Atoll and CCAFS has been completed. The following sections summarize and update the assessment of impacts of construction prepared by USASDC in 1987 and address impacts of operation during the Starbird engagements.

4.3.1 Wake Island

4.3.1.1 Land use

About 6 acres (2.4 ha) of land is being used for construction and renovation activities in support of the proposed action. The development of this area represents an insignificant impact to land use because it is a small amount of the total undeveloped land on the islands and cleared areas will be allowed to return to native vegetation after completion of the project. Renovation of existing buildings represents a small impact to island land use because the general uses of the abandoned buildings are not being changed. Preparation of the radar and telemetry sites on Wilkes involves minor clearing for an access way to the telemetry site in previously disturbed land areas. No construction of facilities is involved. The MRTS site requires only the addition of a power supply link adjacent to a softball field. The Wake Island radar site requires no site work.

Impacts from Starbird operations on the use of nearby facilities would be minor, with implementation of planned mitigation measures because facilities on the island are operated by USAF and the protection of personnel and other activities can be coordinated with the proposed action.

4.3.1.2 Ecological resources

Terrestrial resources. Construction has mainly taken place on areas that were already occupied by existing buildings, roads, and concrete aprons. In addition, a total of roughly 6 acres (2.4 ha) of vegetation was cleared for the various new facilities—4.4 acres (1.8 ha) on Wake Island and 1.6 acres (0.6 ha) for the telemetry and radar sites on Wilkes Island. These acreages include about 3.8 acres (1.5 ha) being graded, of which about 1.9 acres (0.8 ha) are occupied by new facilities (buildings, MRTS vans, roads, concrete aprons, and a telemetry pad). The types of vegetation that were affected include shrubby habitats interspersed with areas of bare ground, grass, and scattered small trees. About 1.4 acres (0.6 ha) of this vegetation is adjacent to existing facilities. No unique or unusual vegetation types or wetlands has been affected.

The nesting bird colonies on Wilkes and Peale islands are not located on or adjacent to any of the proposed project sites and, thus, were not directly affected by construction of the proposed projects. Few birds of solitary nesting species apparently nest on or in the immediate vicinity of the project sites on Wilkes and Wake islands. No evidence of recent nesting was observed at the project sites during recent surveys (Appendices A and D). Although about 6 acres (2.4 ha) of potential seabird nesting habitat at the sites was cleared and a slight decrease in seabird population could have occurred as a result, it is anticipated that any effects have been minimal on Wake Island due to the apparent lack of nesting at the sites and the presence of existing but abandoned facilities at five of the ten Wake Island sites.

On Wilkes Island, potential impacts from human activities in general could occur. The island has been little disturbed by military activities and facilities since World War II. The only major facility is a liquid fuel storage area at the island's east end. A small radio transmitter facility is located at the west end of the island. Large nesting bird colonies are present on the west end of the island away from areas of relatively intense human activity and most existing buildings and facilities. The mobile telemetry and radar facilities are being located at relatively undeveloped sites adjacent to the northern shore at the center of the island. Increased development and operations in this area could make the island a less attractive area to the seabirds that nest in large numbers at the west end of the island. Thus, it is possible that the bird colonies could experience some adverse impacts. Human disturbance in numerous documented cases, particularly human intrusion into nesting colonies, has had adverse impacts on seabird populations (Anderson 1988, Manuwal 1978). The possibility of disturbance to the birds is limited, however, because the equipment is mobile and will be removed after the project, and personnel who are operating or using the facilities will be instructed to stay away from nesting birds. Therefore, although impacts may occur, it is anticipated that adverse impacts on the birds would not be significant.

The increased work force on Wake Atoll during the Starbird activities could result in increased human intrusion into important seabird nesting areas. Such impacts would be additive to adverse impacts already occurring due to predation by rats and feral cats and dogs on Wilkes and Peale islands. Existing impacts have developed over time and are not related to the Starbird project.

No hazardous or toxic liquids are being used during construction except diesel fuel and gasoline, and large quantities of these substances are not being used or stored at the construction sites. Spills of small quantities of these liquids would quickly soak into the permeable soils found on the islands and would not spread out and affect a large area of terrestrial habitat. Any contaminated soils would cleaned up immediately after a spill.

The operational phase of the project should have negligible effects on vegetation and wildlife habitat. Human disturbance of wildlife would minimized by precluding unauthorized entry to Wilkes and Peale islands. Any spills of hazardous materials used would be small, would be cleaned up, and would not affect significant areas of terrestrial habitat. Air pollutants emitted by combustion of the solid rocket fuel—primarily hydrogen chloride, aluminum oxide, and carbon monoxide—would have little effect on air quality. The amounts of these air pollutants would be roughly 100 to 200 times smaller than those produced by Titan and space shuttle launches at CCAFS. It is unlikely that part of a launch vehicle would accidentally fall onto a nesting seabird colony or that launch vehicle engine noise would significantly impact nesting success. The launch pads are about 2 miles (3.4 km) east-southeast and southeast of Wilkes and Peale islands, respectively (Fig. 2-5). The Starbird vehicle would be launched toward the northeast, a direction that would preclude a launch vehicle from approaching or overflying Wilkes or Peale islands. Decommissioning the launch facilities after the completion of the Starlab project would also have negligible impacts.

Fires, explosions, or inadvertent ordnance initiation could (if any occurred) eliminate some terrestrial biota in the vicinity of the launch pads. Following such accidents, vegetation would eventually become reestablished in the affected area.

Aquatic resources. The construction of the Starbird launch site and preparation of sites for instrumentation vans, radar, and telemetry should not have any adverse affect on aquatic life. Likewise, launching of the Starbird vehicles would have no effect. It is highly unlikely that any debris falling from the vehicles after launch would affect any resource of concern.

4.3.1.3 Threatened and endangered species

No impacts on endangered and threatened species are likely to occur because only one federally listed threatened species, the green sea turtle, is known to be present in the area, and it would not be affected by either construction or operation activities. To ensure that sea turtles are not disturbed, a program would be implemented to educate all personnel working on or visiting the atoll not to harm or harass any sea turtles found in the near-shore waters. Consultation with the USFWS under Section 7 of the Endangered Species Act of 1973 has been completed (Appendix G).

4.3.1.4 Socioeconomic and cultural resources

No impacts to socioeconomic resources would be expected from construction or operation of Starbird project activities. Adequate existing housing and support services are available for work crews and technical staff.

Potential impacts on historic resources during project construction activities could occur because Wake Island is designated a National Historic Landmark. USASDC has developed mitigation plans to avoid impacts on historic and cultural resources and has obtained concurrence from the National Park Service, Museum of the Marianas, and the President's Advisory Council on Historic Preservation (Appendix G).

4.3.1.5 Human health and safety

Discussions in Sect. 4.2.1 relative to illumination laser intensity are applicable for Starbird engagements. The nominal location of the laser footprint would be maintained 12 miles (20 km) offshore. This location, combined with the safety controls discussed below, would ensure that inadvertent illumination did not occur.

An examination was made for occurrences that could result in the light path crossing unrestricted areas. The practical possibilities described in PEP-20 (LMSC 1989) are limited to:

- premature operation of laser systems
- inadvertent operation of laser systems
- malfunction or unplanned operation of laser systems (the laser pointing outside of planned illumination zone).

Premature or inadvertent operation of the illuminator laser could occur from electrical failure, software/firmware programming error, mechanical failure or operator error. In order to ensure lasers would not lase in an unplanned manner, controls have been developed for times prior to the engagement and after the engagement.

Prior to an engagement, deliberate payload crew actions would be required to open protective enclosure doors; turn on the illuminator laser electronics; turn on the illuminator laser pump; enable the illuminator laser mechanical shutter to be opened and software command the illuminator to lase. The timing of these events would be controlled by a detailed procedural plan. After an engagement, a software timer closes the shutter and turns off the laser. The payload crew would manually command the shutter closed and turn off electrical power to the laser. Software would also close the laser shutter if the target moved out of the coarse tracker.

To ensure that the illuminator laser would not mispoint outside of the planned illumination zones, restrictive provisions have been made. An automatic software shutoff would close the illuminator if the laser mispoints. A backup to this automatic shutoff would be provided so the payload crew could monitor the target on the video monitor showing the coarse tracker. If the target image moved off the coarse tracker, the crew could manually close the illuminator laser shutter. The Space Test Objects engagement (Sect. 2.1.3.2) and the ground calibration

experiments (Sect. 2.1.3.3) would be performed prior to the Starbird engagements in order to determine that the illuminator laser was properly boresighted.

Given the safeguards built into the laser and its pointing system, the minor size of the illumination zone, and the fact that the laser beams are only hazardous if illumination is directly viewed using optical assistance, the likelihood of harm coming to any individual would be remote.

In addition to the precautions already mentioned, an added control is that the payload crew must assure that the Starbird plume is a unique target. The brightness of the plume is anticipated to be unique, and there would be no similar light sources in the area that might be mistaken for the plume. Because these engagements would be over the ocean surface, there is little likelihood that anyone, especially someone using optical assistance, would view the illuminating laser. An added safety feature relates to impact safety issues. Prior to launch, sea lanes would be cleared for re-entering spent Starbird stages. This fact alone reduces the probability of optically aided viewing. No adverse effects are foreseen.

The proposed launches of the Starbird vehicles would produce brief but intense sound events. There could be as many as three separate launches at Wake Island during the Starlab mission. Typical noise and also several sonic booms would occur during each launch. Noise levels from the relatively small engines to be used would be less than those associated with launches of larger vehicles at other facilities (e.g., CCAFS). Routine measures would be used to protect personnel from the intense noise occurring near the launch pad. During the time that the Starbird vehicle exceeded the speed of sound, a sonic boom would be directed toward the front of the vehicle down range of Wake Atoll and over the ocean.

4.3.2 Cape Canaveral

4.3.2.1 Land use

The renovation of LC 20 for the Starbird project represents a continuation of a previous land use. The clearing of about 1 acre (0.4 ha) of vegetation around the perimeter of LC 20, however, has slightly increased the amount of developed land on CCAFS. Figure 2-7 shows the location of construction, modifications, and renovations for the Starbird activities at CCAFS.

4.3.2.2 Air quality

Sources of air pollutants from operation of the project would be a back-up electrical generator and the launch vehicle itself. As discussed in Sect. 4.4.1.2, air pollutants emitted by combustion of the solid rocket fuel would have little effect on air quality. All emissions would be insignificant, and none would require a Prevention of Significant Deterioration (PSD) permit from the State of Florida or the U.S. Environmental Protection Agency. The air quality impacts of LC 20 renovation and vehicle launches for the Medium Launch Vehicle II Program, a much larger program than the proposed Starbird activity at CCAFS, were addressed in more detail in a previous EA (USAF 1989) and were also found to be insignificant.

4.3.2.3 Ecological resources

Terrestrial resources. Construction activities and laydown of construction materials have been completed and are documented in the Starbird EA (U.S. Army 1987). A small amount of plant and animal habitat has been destroyed [about 1 acre (0.4 ha)], and impacts have been minimal. Some loss of gopher tortoise habitat resulted from construction, and a few tortoise fatalities may have occurred during construction. Noise associated with construction may have temporarily disturbed wildlife. Wildlife near LC 20 should, however, be somewhat accustomed to human activities occurring at CCAFS and should not have experienced any significant population decline due to construction noise.

Starbird launches at LC 20 would result in noise and burnt propellant emissions to the air. Emissions from the launch vehicle exhausts would not significantly affect air quality and would not produce high concentrations of toxic substances that would significantly damage vegetation or wildlife habitat. Emissions and effluents from other routine launches of much larger vehicles at CCAFS are not known to have had adverse long-term impacts on terrestrial biota. Launches would generate intense noise levels of short duration (i.e., < 30 s) at CCAFS. These noise levels could damage the hearing of animals near the launch complex. Although information is lacking for animals exposed to launch vehicle noise, individual animals of several species have been shown to lose hearing ability when exposed to intense off-road vehicle noise of relatively short duration [e.g., 95 dBA for 8 min (Brattstrom and Bondello 1983)]. The survival of individual animals that experience hearing loss could be jeopardized (e.g., because of increased susceptibility to predators), and a small temporary decrease in population density could theoretically occur near LC 20 after a launch.

Sonic booms would be expected to occur only over the Atlantic Ocean and to be inaudible to wildlife at CCAFS or other coastal areas. The booms could produce a startle response in certain marine birds and mammals on or above the water surface but would not be expected to have any effect on the abundance or health of their populations. Sonic booms generally have been found to have no significant effect on wildlife populations (Jehl and Cooper 1980, Teer and Truett 1973, Runyan and Kane 1973).

Fires, explosions, or inadvertent ordnance initiation could eliminate some terrestrial biota in the vicinity of LC 20. Following such accidents, vegetation and wildlife would eventually become reestablished in the affected areas.

Impact minimization for the proposed project would include standard practices as necessary for the control of hazardous substances that could affect wildlife populations or their habitats (CCAFS, Operation Plan 19-1, Oil and Hazardous Substance Pollution Contingency Plan). Because the proposed project, including the above measures for impact prevention, should not result in significant habitat loss or reductions in wildlife populations, no additional mitigation to compensate for impacts on terrestrial biota is planned.

Aquatic resources. No impacts on marine or freshwater species or habitat are expected.

4.3.2.4 Threatened and endangered species

Threatened and endangered species are not expected to be affected significantly by the proposed project because little loss of habitat has occurred. The hearing of scrub jays and possibly other species near the launch pad might be affected adversely by intense launch vehicle noise. A limited amount of mortality could result indirectly from hearing loss (e.g.; because of increased susceptibility to predators). This impact would be temporary, however, and should not cause a long-term decrease in population levels.

Illumination of the launch pad at night could exacerbate an existing problem affecting endangered sea turtles at CCAFS. Emerging sea turtle hatchlings have been shown to be attracted to artificial lighting inland from the beach, whereupon they experience increased mortality due to desiccation and predation (Murphy 1987, Witham 1982). Lights at LC 20 could contribute to this impact. In response to general concerns about the potential effects of lights at CCAFS on sea turtles and in compliance with Section 7 of the Endangered Species Act, the USASDC has consulted with the USFWS and submitted an LMP designed to prevent lighting impacts of LC 20 on sea turtles. This LMP (Appendix H) was approved by the USFWS (D. J. Wesley, USFWS, letter to Colonel J. E. Green, Jr., U.S. Army, October 25, 1989) (Appendix G). The USASDC is committed to ensuring that LC 20 would not have the potential to cause sea turtle disorientation (Leonhard 1989).

In the Banana River that runs along the eastern boundary of CCAFS (Fig. 2-6), the endangered Caribbean manatee would not be affected adversely by this project. No effluents would enter the river from the interlocking canals, and no habitat degradation would be expected to occur. Handling of all toxic and hazardous materials must conform to Air Force Manual 127-1, which is stringently enforced by the USAF.

4.3.2.5 Socioeconomic and cultural resources

The Starbird EA (U.S. Army 1987) determined that no significant impacts would occur to socioeconomic resources from renovation and construction activities because a large number of workers would not be required. Impacts of operations would require a maximum workforce of 40 people over a 1- to 2-month period. Operations would not significantly affect surrounding residents or communities because they would be compatible with the normal types of activities associated with CCAFS and because only a few launches would take place during the entire period. The USASDC has consulted with the State Historic Preservation Office (SHPO) to ensure that no impacts to significant historic or archaeological resources would occur (Appendix G).

4.3.2.6 Human health and safety

The Starbird launch from CCAFS is qualitatively identical to that discussed for Wake Island (Sect. 4.3.1.5), and no significant impacts are anticipated. The major differences are the larger populations of humans on land and the proximity to the numerous launch complexes at CCAFS.

This latter point requires that additional caution be taken in sighting on the Starbird plume to prevent sighting on other bright lights associated with a different function at CCAFS.

The proposed launches of the Starbird vehicles would produce brief but intense sound events. There could be as many as three separate launches during the Starlab experiments. Typical noise and also several sonic booms would occur during each launch. Noise levels from the relatively small engines to be used would be less than those associated with many other launches of larger vehicles at CCAFS. Routine measures would be used to protect personnel from the intense noise occurring near the launch pad. LC 20 is sufficiently isolated from public areas to preclude any impact of launch noise on public health. During the time that the Starbird vehicle exceeds the speed of sound, a sonic boom would be directed toward the front of the vehicle down range of LC 20 and over the ocean.

4.4 IMPACTS OF SHORT WAVE ADAPTIVE TECHNOLOGY EXPERIMENT

4.4.1 Land Use

Because the SWAT experiment would use existing buildings at AMOS, no new construction would occur as a result of the Starlab program. No need exists to use any new land area at AMOS for the storage of any materials. The Starlab experiments that would be conducted are similar in nature of other laser beam experiments that have taken place at this site in the past. No land-use permits or changes in the terms of the existing USAF lease for use of this site would be legally required (B. D. Bauer, Deputy Assistant General Counsel, USAF, memorandum to Mr. Lindenhof, LEEIE, USA, July 17, 1990).

4.4.2 Ecological Resources

Terrestrial resources. Because no construction activities are involved with the SWAT experiment at AMOS, there would not be any significant loss or damage of plant and animal habitats. The rare silversword plant that has been transplanted at AMOS would not be affected. Operation of the facility would involve the use of laser beams and the production of small amounts of air pollutants, and would have no adverse impact on ecological resources. Potential impacts of lasers on wildlife in general are discussed in Sect. 4.2.2. Wildlife species of concern at AMOS are discussed in Sect. 3.3.3 and include the Hawaiian dark-rumped petrel, Hawaiian goose or nene, and the Hawaiian hoary bat. Potential impacts on these species are discussed in Sect. 4.4.3.

Aquatic resources. No impacts to aquatic resources would occur because no such resources are present on the site.

4.4.3 Threatened and Endangered Species

During the projection of laser beams back and forth between AMOS and the shuttle, it is unlikely that flying or resting nene (Hawaiian geese), dark-rumped petrels, or hoary bats would be exposed to laser beams for the following reasons: (1) a misdirected laser beam from the shuttle, which is unlikely to occur, would be turned off immediately; (2) it is unlikely that nene or Hawaiian bats would be in the vicinity of AMOS during laser operation; and (3) if any nene, petrels, or bats were flying in the AMOS vicinity during laser operation, they would be unlikely to fly through the beam due to the narrowness of the beam and the short duration of the experiment. Nene occur primarily in habitats located at elevations considerably lower than AMOS (Sect. 3.3.4, USAF 1988), where no exposure to laser beams would occur except possibly in the case of a misdirected beam. Petrels nest in deep burrows inside and outside the Haleakala Crater (Sect. 3.3.4); the nearest burrow is reported to be about 114 m (375 ft) from the AMOS site. Petrels in their burrows would not be exposed to lasers, but any bird resting near the burrow could be exposed only if a beam were misdirected. A few sightings of the Hawaiian hoary bats have been made at the summit of Mount Haleakala, but this species resides primarily in lowland forests (Sect. 3.3.3, USAF 1988) and is unlikely to be found resting near the AMOS site. Even if an exposure of these species to a laser beam did occur, it would be highly unlikely to have an adverse effect on any individual bird or mammal, as discussed in Sect. 4.2.2. Any exposure time for an individual animal would be extremely short (e.g., 25 nanoseconds, Sect. 4.2.1), and the exposure level would be orders of magnitude below the MPE (Sect. 4.2.2). Therefore, no adverse impacts on the populations of nene, petrels, or bats would be likely to occur. Concurrence that threatened or endangered species will not be significantly affected has been obtained from the U.S. Fish and Wildlife Service, and formal consultation under the Endangered Species Act is thus not required (Appendix G).

No additional exterior lighting would be associated with the proposed project. Also, the laser source would not be visible except within the narrow beam of laser light, as explained in Sects. 4.2.1 and 4.2.2, and the laser beam would not create a significant amount of widespread diffused light around AMOS. Therefore, the general light level during the night at AMOS would not be increased, and seabirds such as the petrel should not suffer mortality due to artificial lighting as they have on the island of Kauai (Telfer et al. 1987). Negligible quantities of air pollutants would be emitted by the proposed project.

4.4.4 Socioeconomic and Cultural Resources

The use of the AMOS for the SWAT experiments would have no adverse impacts on socioeconomic resources because no significant increase in the number of personnel at AMOS would occur and no new facilities would be built. In addition, no impacts on historical or archaeological resources are anticipated at AMOS because no construction activities would occur.

4.4.5 Human Health and Safety

The SWAT experiment planned for the Starlab program is quite similar to the proposed RME, with the exception that in SWAT the two land-based lasers would be located at the same facility rather than miles apart. All of the transmission and reception of laser beams during the Starlab experiment would take place at the AMOS facility, in contrast to the RME, in which two separate facilities would be involved that are miles apart. In addition to the placement of both lasers at the same facility, the SWAT laser systems would operate at lower power levels than those that would be used during the RME laser operations.

From a health and safety point of view, the SWAT program has essentially the same mission as the RME. Each mission would involve sending a blue illuminator laser beam to a space object, which would then reflect the laser beam back to earth. A green laser beam would then be sent up to the space object. Although many of the specifics about the experiments carried on within the beams are different, the health and safety issues, which relate to the beam intensities and the likelihood for human exposures to the beams, would be nearly identical.

Because of the similarity of the two experiments from the health and safety point of view, it is instructive to review the work performed for the RME as reported in the Environmental Impact Analysis Process (EIAP) conducted for that experiment (USAF 1987, 1988). This assessment found that while human eye hazards exist, there is negligible risk related to actual exposures under any foreseeable conditions. Laser illumination from Starlab for safety purposes would be essentially the same as discussed earlier in Sect. 4.2.1, except that only the marker laser would be employed. The marker laser would be only two times the MPE at its exit point. Divergence plus absorption in the atmosphere would render the beam's power density at the earth's surface to well below the MPE, even with high-powered binoculars. No eye hazards would be expected to result from Starlab lasers during the proposed experiments on Maui.

Two lasers, a blue illuminator laser that would be reflected back to AMOS and a green uplink laser, would be used at AMOS during the SWAT experiment. The blue laser would contain information on the wavefront deformation caused by transmission through the atmosphere. The green laser would attempt to compensate for this measured deformation. Both lasers would be directed to Starlab from the Laser Beam Director (LBD) at AMOS. The LBD is a beam expander and precision pointing device with a 24-in (60-cm) aperture. Its acquisition and control system would be tied into a radar tracking system. This beam director has been used for many years to propagate various lasers through the atmosphere. The SWAT program is a continuation of such laser propagation use. During the Starlab engagement, the LBD would not be pointed below 30° above the horizon, thus precluding any inadvertent exposure of humans or land-based animals to laser lights.

MPE levels have been calculated for the blue illuminator laser and the green uplink laser (USAF 1987, 1988). The intensity of the green uplink laser is below the MPE, while the intensity of the blue illuminator laser is greater than the MPE. However, upon its return to ground, the blue illuminator laser beam would be well below the MPE.

In spite of the limited eye hazard, safety and operational procedures included in the SWAT experiment would ensure that laser operations would not harm the public or nearby wildlife. The

LBD procedural, electro-mechanical and software mechanisms would not allow laser emissions to be directed less than 30° above the horizon; therefore, the laser beams would pass above any terrain outside the facility boundary. Protection would also be afforded to aircraft flying in the vicinity of Maui through coordination and cooperation with the FAA and other federal agencies. A four stage safety process would contain (1) a controlled firing process (CFP), (2) a posting of notices to airmen, (3) regular broadcasts of pilot advisories during laser operating periods, and (4) a posting of two observers with positive laser control during periods of operation. The CFP is an aircraft control technique used by the FAA and laser operators to ensure that: (1) laser firings are contained within the designated area; (2) aircraft remain outside the laser firing area when lasers may be operating; and (3) if aircraft do enter the designated area, laser operation would be terminated.

The long operating history of AMOS, using a wide variety of laser systems, some more powerful than those to be used in the SWAT experiment, has demonstrated consistently that operational procedures, hardware, and software have resulted in safe operation of the facility consistent with mission accomplishment. Calculations show that hazards do exist—that is, conditions do occur within the facility boundaries that could result in harm to humans. However, exposure to humans is precluded by not projecting the laser beams lower than 30° above the horizon. Therefore, no possibility exists for human or land-based animals to be exposed to laser beams from AMOS because AMOS is already at the top of the mountain. Protection of people in aircraft would be provided by the four stage safety process described above. In conclusion, the SWAT experiment would add no significant impact to the existing level of minimal environmental impact at the AMOS facilities.

4.5 CUMULATIVE IMPACTS

No significant adverse cumulative impacts are anticipated from the Starlab program. The programmatic EIS on the Space Shuttle (NASA 1978) discusses the impacts of up to 40 launches per year from the Kennedy Space Center. The Starlab mission would use one of these launches and would, therefore, contribute incrementally to the environmental impacts from the Space Shuttle. These impacts, which have been addressed in the NASA EIS and can be adequately mitigated, would occur with or without the Starlab program.

The only possible cumulative effects from exposure to laser light would be by repeated exposure of the eye or skin to beams of greater intensity than the respective MPEs for these organs. There would be a maximum of three passes each at CCAFS and Wake Island. Exposure would be precluded by operational parameters, especially the fact that the laser that could exceed the MPEs (i.e., the illuminator laser) would always be pointed at least 30° above the horizon, thus avoiding any exposure to humans or wildlife on land.

When the Starlab mission is complete, the small satellites deployed for the STOs experiment would remain in orbit no more than 6 months. These STOs would, therefore, add a small increment to the accumulation of space debris [at least 7000 objects with diameters ranging from several meters to about 10 cm (Eberhart 1990)] for a short time. The STOs would

eventually reenter the atmosphere, where they would most likely burn up. Even in the event that some pieces return to earth, it is highly unlikely (less than a 10^{-6} probability) that they would impact land.

Construction impacts associated with the Starbird projects on Wake Island and CCAFS are temporary, and when mitigated as discussed in the Starbird EA, the LMP, and the FONSI, should not be significant. The cumulative impacts caused by the clearing of vegetation from the various Starbird sites is a small fraction of the total area that has already been disturbed or that is occupied by existing facilities. Because of the small size of the atoll, however, cumulative impacts are an important concern and should be minimized to the maximum extent feasible. The fact that seabirds on Wake Atoll have located their colonies as far away as possible from existing facilities and human disturbance suggests that human developments are not compatible with these birds. Therefore, expansion of developed areas closer to these colonies could have adverse cumulative impacts. Although the mobile radar and telemetry facilities will be located near a bird colony on Wilkes Island, construction activities are limited, and the facilities will be removed after the Starlab mission is completed. Therefore, it is not anticipated that the cumulative impacts on the bird colonies would cause a significant long-term population decline. Launches of Starbird vehicles at Wake Island would not be expected to have any long-term impact because a maximum of three launches are planned, and no sensitive resources have been identified that would be affected. Possible use of Starbird launch facilities on Wake Island after the Starlab engagements could result in cumulative impacts.

No significant cumulative impacts from the Starbird project at CCAFS are expected on land use, air quality, or surface water and groundwater quality. A small cumulative impact on vegetation and wildlife has occurred due to the clearing of less than 1 acre (0.4 ha) at LC 20. Although the cumulative impacts of the project would be very small and probably negligible, cumulative impacts at CCAFS are a concern because the Station supports important habitats for a variety of T&E species whose habitats in the areas surrounding CCAFS are becoming increasingly smaller due to human development. The LMP (Appendix H) developed to prevent cumulative impacts on T&E sea turtles at LC 20 is, therefore, an important mitigation measure to prevent cumulative impacts from occurring.

No cumulative impacts would occur at AMOS as a result of the SWAT engagements. No new facilities would be constructed outside of existing buildings, and use of lasers for the Starlab experiment would not be expected to have any environmental impact.

5. CONSULTATION AND COORDINATION

5.1 INTRODUCTION

The Starlab experiments and engagements would involve construction and operation activities in the United States and its territories (i.e., Florida, Hawaii, Wake Island), and on foreign countries (Antigua and Ascension Island). In compliance with AFRs 19-2 and NEPA, the USAF has prepared this EA to evaluate potential environmental impacts associated with the Starlab activities and will comply with all other environmental requirements of federal and state laws and regulations and treaty agreements with other countries. Separate environmental documentation for the ground calibration sites on Antigua and Ascension Island is being prepared under AFR 19-3 (Sect. 1.2).

5.2 STARBIRD ENGAGEMENTS

Construction and launch activities at Wake Island and CCAFS for the Starbird experiments are the responsibility of USASDC. These activities require consultation with the USFWS and state fish and wildlife agencies under the Fish and Wildlife Coordination Act and Section 7 of the Endangered Species Act and with the SHPO or, in the case of Wake Island, with the President's Advisory Council on Historic Preservation (ACHP) under the National Historic Preservation Act. The consultation process has been completed at both Starbird sites (Appendix G). The USASDC is complying with other environmental review or permit requirements required for construction, operation, and dismantling of the launch facilities as required by the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act, and other pertinent federal and state laws and regulations.

5.3 SWAT EXPERIMENT

Activities associated with the SWAT experiment would utilize existing facilities at AMOS and will fall within the existing approvals for operating that facility. Consultation with the USFWS under the Fish and Wildlife Coordination Act and Section 7 of the Endangered Species Act has been completed and the USFWS has concurred with the findings of this EA and stated that no additional consultation is required (Appendix G).

5.4 AGENCIES CONSULTED

The following agencies were contacted during preparation of the Starlab EA. Consultation on the Starbird project is documented in the Starbird EA (U.S. Army 1987) and supplemented as appropriate in the present EA.

Hawaii Division of Forestry and Wildlife, Honolulu, Hawaii; Thaine Pratt

U.S. Fish and Wildlife Service, Honolulu, Hawaii; Stewart Fefer, William Kramer, and Craig Rowland

U.S. Fish and Wildlife Service, Atlanta, Georgia; David Fleming and Dennis Chase

U.S. National Marine Fisheries Service, Honolulu, Hawaii; Gene Nitta

U.S. National Marine Fisheries Service, Jacksonville, Florida

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7. LIST OF PREPARERS

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R. L. Kroodsma, Ph.D., Zoology, North Dakota State University; M.S., Zoology, North Dakota State University; B.A., Biology, Hope College; 17 years' experience in environmental impact assessment. Contribution: Terrestrial ecology for Wake Island, Maui, and Cape Canaveral.

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APPENDIX A

BIOLOGICAL SURVEY

WAKE ISLAND STARLAB PROJECT SITES

APPENDIX A

BIOLOGICAL SURVEY

WAKE ISLAND STARLAB PROJECT SITES

United States Department of the Interior

FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS OFFICE
P.O. BOX 50167
HONOLULU, HAWAII 96850

TAKE PRIDE IN AMERICA

APR 2 7 1989

Mr. John R. Edwards
Environmental Planning Division
Department of Air Force
Headquarters Space Division
Los Angeles Air Force Base
P.O. Box 92960
World Way Postal Center
Los Angeles, CA 90009

Dear John:

Enclosed please find 9 copies (1 original and 8 photocopies) of the report documenting the results of our survey of alternative sites for the Starlab Project on Wake Island. The survey was completed during April 5-12, 1989 by Mr. Craig Rowland of this office. I have sent 10 copies of this report to Mr. Robert Reed and 2 copies to Mr. Daniel Evans under separate cover.

This report includes the information on terrestrial wildlife resources needed by the Air Force in preparing an Environmental Assessment of the potential environmental impacts associated with the Starlab Project.

We will be preparing an additional report on the wildlife resources present on Wake Island during this visit within the next few weeks. This report will include the results of wildlife surveys conducted on areas of Wake Atoll not included as Starlab Project sites. I will forward copies of this report to you and the other offices receiving copies of the Starlab Project Report.

Thank you for providing the opportunity for us to assist you. If we can be of further assistance or you require additional information, please feel free to contact Craig or me at 808-541-1201.

Sincerely yours,

Stewart I. Fefer
Refuge Complex Manager
Hawaiian/Pacific Islands NWRs

cc: Mr. Robert Reed
Daniel M. Evans

Biological Survey
Wake Island Starlab Project Sites

Introduction:

A biological survey of the alternate project support sites for the Starlab Project on Wake Island was conducted from April 5 - 12, 1989 by personnel from the Honolulu office of the U.S. Fish and Wildlife Service. This survey covers the terrestrial habitat of the proposed Starbird Project sites. The results from a survey of the marine habitat will be provided by the National Marine Fisheries Service.

Methods:

The following project sites were examined during this survey:

Missile Assembly Building (Bldg. 1644)
Missile Storage Building (Bldg. 1607)
Barracks Buildings (Bldgs. 1175 and 1176)
Payload and Launch Support Building (Bldg. 1601)
Launch Site No. 1
Launch Site No. 2
Wind Tower
Pyrotechnic Storage Building (Bldg. 1642)
Two Guardhouses
Radar Site
Telemetry Site
MRTS Site

In addition to these sites, a survey of the entire atoll (Peale, Wilkes and Wake Islands) was conducted to determine existing wildlife populations.

The following information was collected at each site:

Current land use.
Level of existing disturbance.
Presence and description of any unique shoreline, intertidal or wetland area.
General description of plant and animal populations.
Description of seasonal presence or absence of any animal species of special concern.
Presence of protected plant or animal species (including those listed or proposed as threatened or endangered).
Description of mitigation required at proposed site.

Results:

Site: Missile Assembly Building (Bldg. 1644)

Proposed action: Renovate existing Missile Assembly Building (Bldg. 1644)

A: Clear vegetation within 50 feet of building; involves about 0.3 acres and 70 trees 1-6 inches in diameter and 3-20 feet high. The building is surrounded on three sides by existing roads and pavement.

B: Remove several small structures.

C: Possible installation of electric utility line.

Current use of land: Abandoned missile assembly building

Level of existing disturbance: No existing disturbance

Unique shoreline, intertidal or wetland area: None present

General description of plant and animal populations: Only two plant species are present at this site, the shrub Tournefortia argentea and the grass Lepturus repens. There were no birds seen at this site and there was no evidence of recent nesting in this area. See photo 1.

Seasonal presence of animal species of special concern: The type of vegetation present could provide suitable nesting habitat for the Red-tailed tropicbird (Phaethon rubricauda), White tern (Gygis alba), Black noddy (Anous minutus) and Great frigatebird (Fregata minor). Whether these species choose to nest in this area was not determined due to the fact that the survey did not coincide with their nesting seasons. This area also contains habitat that could possibly be used as nesting areas for other birds presently found on the atoll; Sooty tern (Sterna fuscata), Red-footed booby (Sula sula), Brown booby (Sula leucogaster) and Masked booby (Sula dactylatra). These birds were nesting elsewhere on the atoll at the time of the survey and have not been reported to nest in this location.

Presence of protected plant or animal species: Possible seasonal presence of Red-tailed tropicbirds, White terns, Black noddies, and Great frigatebirds during nesting season. All of these bird species are protected under the Migratory Bird Treaty Act.

Description of on site mitigation: The U.S. Fish and Wildlife Service requires that the procedures outlined in section 3.4.1.6 of the Starbird Project Environmental Assessment be followed, with the addition that the survey to be conducted just prior to commencement of construction, be performed by a qualified wildlife biologist.

Site: Missile Storage Building (Bldg. 1607)

Proposed action: Clearing and grading around existing Missile Storage Building (Bldg. 1607)

A: Cut and remove 9 trees.

B: Clear and grub vegetation within 50 feet of the building (involves about 0.5 acre.

Current use of land: Abandoned building with PCB warning signs posted

Level of existing disturbance: No existing disturbance

Unique shoreline, intertidal or wetland area: None present

General description of plant and animal populations: The plant species present at this site are the following:

Beach heliotrope, (Tournefortia argentea)
grass, (Lepturus repens)
Ironwood trees (Casurina equisetifolia)
various introduced weeds.

There were no birds seen at this site and there was no evidence of recent nesting in this area. See photo 2.

Seasonal presence of animal species of special concern: The type of vegetation present could provide suitable nesting habitat for the Red-tailed tropicbird (Phaethon rubricauda), White tern (Gygis alba), Black noddy (Anous minutus) and Great frigatebird (Fregata minor). Whether these species choose to nest in this area was not determined due to the fact that the survey did not coincide with their nesting seasons. This area also contains habitat that could be used as nesting areas for other birds presently found on the atoll; Sooty tern (Sterna fuscata), Red-footed booby (Sula sula) and Masked booby (Sula dactylatra). These birds were nesting elsewhere on the atoll at the time of the survey and have not been reported to nest in this location.

Presence of protected plant or animal species: Possible seasonal presence of Red-tailed tropicbird, White tern, Black noddy and Great frigatebird during nesting season. All of these bird species are protected under the Migratory Bird Treaty Act.

Description of on site mitigation: The U.S. Fish and Wildlife Service requires that the procedures outlined in section 3.4.1.6 of the Starbird Project Environmental Assessment be followed, with the addition that the survey to be conducted just prior to commencement of construction, be performed by a qualified wildlife biologist.

Site: Barracks Buildings (Bldgs. 1175 and 1176)

Proposed action: Renovate existing Barracks (Bldgs. 1175 and 1176)
A: Trim trees
B: Remove portions of existing concrete walkways
C: Install electric utility line.

Current use of land: Abandoned barracks

Level of existing disturbance: No existing disturbance

Unique shoreline, intertidal or wetland area: None present

General description of plant and animal populations: The plant species at this site are:

grass, (Lepturus repens)
Ironwood trees (Casurina equisetifolia)
other introduced trees
various introduced weeds

There were no birds seen at this site and there was no evidence of recent nesting in this area. See photo 3.

Seasonal presence of animal species of special concern: The type of vegetation present could provide suitable nesting habitat for Red-tailed tropicbirds (Phaethon rubricauda) and White terns (Gygis alba). Whether these species choose to nest in this area was not determined due to the fact that the survey did not coincide with their nesting seasons.

Presence of protected plant or animal species: Possible seasonal presence of Red-tailed tropicbirds and White terns during nesting season. Both of these bird species are protected under the Migratory Bird Treaty Act.

Description of on site mitigation: The U.S. Fish and Wildlife Service requires that the procedures outlined in section 3.4.1.6 of the Starbird Project Environmental Assessment be followed, with the addition that the survey to be conducted just prior to commencement of construction, be performed by a qualified wildlife biologist.

Site: Payload and Launch Support Building (Bldg. 1601)

Proposed action: Renovate existing Payload and Launch Support Building (Bldg. 1601)

A: Trim trees north of building.
B: Remove several shrubs on east and west side of building.
C: Clear vegetation other than trees in an area of about 0.25 acre adjacent to building.
D: Remove several existing structures.

Current use of land: Abandoned payload and launch support building

Level of existing disturbance: No existing disturbance

Unique shoreline, intertidal or wetland area: None present

General description of plant and animal populations: The plant species found at this site are the following:

grass (Lepturus repens)
Ironwood trees (Casurina equisetifolia)
various introduced weeds

Two large ironwood trees (10 inch diameter) on the south side of the building have been cut down contrary to what the plans call for.

There were no birds seen at this site and there was no evidence of recent nesting in this area. See photo 4.

Seasonal presence of animal species of special concern: The type of vegetation present could provide suitable nesting habitat for Red-tailed tropicbirds (Phaethon rubricauda) and White terns (Gygis alba). Whether these species choose to nest in this area was not determined due to the fact that the survey did not coincide with their nesting seasons.

Presence of protected plant or animal species: Possible seasonal presence of Red-tailed tropicbirds and White terns during nesting season. Both of these bird species are protected under the Migratory Bird Treaty Act.

Description of on site mitigation: The U.S. Fish and Wildlife Service requires that the procedures outlined in section 3.4.1.6 of the Starbird Project Environmental Assessment be followed, with the addition that the survey to be conducted just prior to commencement of construction, be performed by a qualified wildlife biologist.

Site: Launch Site No. 1

Proposed action: Construct new launch facility

A: Clear vegetation within a circle of 100 foot radius (0.72 acre). Grading will occur within an area of about 0.5 acre within the circle.

B: Construct new building and concrete apron (total about 0.2 acre) within the circle. Some of this area consists of an existing concrete slab, a portion of which will be removed.

C: Outside the circle, remove existing berm and use berm material for construction within the circle. Grading may occur within an area of about 0.35 acre East and North of the circle.

D: Install electric utilities.

Current use of land: Unused cement slab

Level of existing disturbance: No existing disturbance

Unique shoreline, intertidal or wetland area: None present

General description of plant and animal populations: The plant species found at this site are the following:

grass, (Lepturus repens)
Beach heliotrope, (Tournefortia argentea)
Naupaka, (Scaevola taccada)
Puka tree, (Pisonia grandis)
Upland cotton, (Gossypium arboreum)
Sour bush, (Pluchia odorata)
various introduced weeds

Also found at this site were open patches of coral rubble and sand. There were no birds seen at this site and there was no evidence of recent nesting in this area. See photo 5.

Seasonal presence of animal species of special concern: The type of vegetation present could provide suitable nesting habitat for the Red-tailed tropicbird (Phaethon rubricauda), White tern (Gygis alba), Brown noddy (Anous stolidus), Black noddy (Anous minutus) and Great frigatebird (Fregata minor). Whether these species choose to nest in this area was not determined due to the fact that the survey did not coincide with their nesting seasons. This area also contains habitat that could possibly be used as nesting areas for other birds presently found on the atoll: Sooty tern (Sterna fuscata), Red-footed booby (Sula sula), Brown booby (Sula leucogaster) and Masked booby (Sula dactylatra). These birds were nesting elsewhere on the atoll at the time of the survey and have not been reported to nest in this location.

Presence of protected plant or animal species: Possible seasonal presence of Red-tailed tropicbirds, White terns, Black noddies, Brown noddies and Great frigatebirds during nesting season. All of these bird spices are protected under the Migratory Bird Treaty Act.

Description of on site mitigation: The U.S. Fish and Wildlife Service requires that the procedures outlined in section 3.4.1.6 of the Starbird

Project Environmental Assessment be followed, with the addition that the survey to be conducted just prior to commencement of construction, be performed by a qualified wildlife biologist.

Site: Launch Site No. 2

There was a discrepancy as to the location of Launch Site No. 2. The map shows the site to be just southeast of the corner of the road leading south from the Launch Support Building and the road leading east from building 1640. Contrary to this information, there is a sign posted, indicating Launch Site No. 2 at the end of the cul-de-sac running south from building 1640. Both of these sites were surveyed and found to have very similar habitat. The information given below is applicable to both of these sites.

Proposed action: Construct new launch facility

A: Clear vegetation within a circle of 100 foot radius (0.72 acre). Grading will occur within an area of about 0.6 acre within the circle.
B: Construct new buildings and concrete apron (total about 0.22 acre) within the circle.
C: Outside the circle, an area of about 0.28 acre to the West of the circle will be graded, and an area of about 0.06 acre to the North and Northeast of the circle will be graded.
C: Install electric utilities.

Current use of land: None

Level of existing disturbance: No existing disturbance

Unique shoreline, intertidal or wetland area: None present

General description of plant and animal populations: The plant species found at this site were the following:

Beach Heliotrope, (Tournefortia argentea)
Sour bush, (Pluchia odorata)
grass, (Lepturus repens)
various introduced weeds
Naupaka, (Scaevola taccada) *
Puka tree, (Pisonia grandis) *

* Found at the site at the end of the cul-de-sac.

There were no birds seen at this site and there was no evidence of recent nesting in this area. See photos 6A and 6B.

Seasonal presence of animal species of special concern: The type of vegetation present could provide suitable nesting habitat for Red-tailed tropicbirds (Phaethon rubricauda), Great frigatebirds (Fregata minor), Black noddies (Anous minutus) and White terns (Gygis alba). Whether these species choose to nest in this area was not determined due to the fact that the survey did not coincide with their nesting seasons. This area also contains habitat that could be used as nesting areas for the Red-footed booby (Sula sula). This species was nesting elsewhere on the atoll at the time of the survey and has not been reported to nest in this location.

Presence of protected plant or animal species: Possible seasonal presence of Red-tailed tropicbirds, Great frigatebirds, Black noddies and White terns

during nesting season. All of these bird spices are protected under the Migratory Bird Treaty Act.

Description of on site mitigation: The U.S. Fish and Wildlife Service requires that the procedures outlined in section 3.4.1.6 of the Starbird Project Environmental Assessment be followed, with the addition that the survey to be conducted just prior to commencement of construction, be performed by a qualified wildlife biologist.

Site: Wind Tower

Proposed action: Construct new wind tower

A: Construct tower road 315 feet long and 15 feet wide. The graded area for the road will be 30 feet wide and about 0.22 acre.

B: Remove two berms and grade berm sites (total area 0.2 acre).

C: Construct wind tower on a site of about 0.02 acre.

Current use of land: None

Level of existing disturbance: No existing disturbance

Unique shoreline, intertidal or wetland area: None present

General description of plant and animal populations: The following plant species were found at this site:

Beach heliotrope, (Tournefortia argentea)
Sour bush, (Pluchea odorata)
Puka tree, (Pisonia grandis)
grass, (Lepturus repens)
various introduced weeds

There were no birds seen at this site and there was no evidence of recent nesting in this area. See photo 7.

Seasonal presence of animal species of special concern: The type of vegetation present could provide suitable nesting habitat for the Red-tailed tropicbird (Phaethon rubricauda), Great frigatebird (Fregata minor), Black noddy (Anous minutus) and White tern (Gygis alba). Whether these species choose to nest in this area was not determined due to the fact that the survey did not coincide with their nesting seasons. This area also contains habitat that could provide nesting area for the Red-footed booby (Sula sula). This species was nesting elsewhere on the atoll at the time of the survey and has not been reported to nest in this area.

Presence of protected plant or animal species: Possible seasonal presence of Red-tailed tropicbirds, Great frigatebirds, Black noddies and White terns during nesting season. All of these bird spices are protected under the Migratory Bird Treaty Act.

Description of on site mitigation: The U.S. Fish and Wildlife Service requires that the procedures outlined in section 3.4.1.6 of the Starbird Project Environmental Assessment be followed, with the addition that the survey to be conducted just prior to commencement of construction, be performed by a qualified wildlife biologist.

Site: Pyrotechnic Storage Building (Bldg. 1642)

Proposed action: Renovate existing building (Bldg. 1642)

A: Clear and grub vegetation in about a 0.27 acre area around existing building.

B: Clear a vehicle path about 12 feet wide and 80 feet long to existing concrete slab.

Current use of land: Abandoned building

Level of existing disturbance: No existing disturbance

Unique shoreline, intertidal or wetland area: None present

General description of plant and animal populations: The following plants are found at this site:

Beach heliotrope, (Tournefortia argentea)
Sour bush, (Pluchea odorata)
Puka tree, (Pisonia grandis)
grass, (Lepturus repens)
various introduced weeds

There were no birds seen at this site and there was no evidence of recent nesting in this area. See photo 8.

Seasonal presence of animal species of special concern: The type of vegetation present could provide suitable nesting habitat for the Red-tailed tropicbird (Phaethon rubricauda), Great frigatebird (Fregata minor), Black noddy (Anous minutus) and White tern (Gygis alba). Whether these species choose to nest in this area was not determined due to the fact that the survey did not coincide with their nesting seasons. This area also contains habitat that could provide nesting areas for the Red-footed booby (Sula sula). This species was nesting elsewhere on the atoll at the time of the survey and has not been reported to nest in this location.

Presence of protected plant or animal species: Possible seasonal presence of Red-tailed tropicbirds, Great frigatebirds, Black noddies and White terns during nesting season. Both of these bird spices are protected under the Migratory Bird Treaty Act.

Description of on site mitigation: The U.S. Fish and Wildlife Service requires that the procedures outlined in section 3.4.1.6 of the Starbird Project Environmental Assessment be followed, with the addition that the survey to be conducted just prior to commencement of construction, be performed by a qualified wildlife biologist.

Site: Guardhouses

Proposed action: Construct two 4 by 6 foot guardhouses.

Current use of land: None

Level of existing disturbance: No existing disturbance

Unique shoreline, intertidal or wetland area: None present

General description of plant and animal populations: Both of the guardhouse sites are located on grass fields with no other vegetation or bird life present. See photos 9 & 10.

Seasonal presence of animal species of special concern: None

Presence of protected plant or animal species: None

Description of on site mitigation: None required

Site: Radar Site

Proposed action: Prepare radar site
A: Clear vegetation in an area of about 0.8 acre.
B: Widen 270 feet of existing road.

Current use of land: None

Level of existing disturbance: No existing disturbance

Unique shoreline, intertidal or wetland area: None present

General description of plant and animal populations: Only two plant species are present at this site, the shrub Tournefortia argentea and the grass Lepturus repens. Patches of bare ground were also present.

There were no birds seen at this site and there was no evidence of recent nesting in this area. See photo 11.

Seasonal presence of animal species of special concern: The type of vegetation present could provide suitable nesting habitat for the Red-tailed tropicbird (Phaethon rubricauda), Great frigatebird (Fregata minor), Black noddy (Anous minutus) and White tern (Gygis alba). Whether these species choose to nest in this area was not determined due to the fact that the survey did not coincide with their nesting seasons. This habitat could provide nesting areas for Sooty terns (Sterna fuscata) and Red-footed boobies (Sula sula). These birds were nesting elsewhere on the atoll at the time of the study and have not been reported to nest in this area.

Presence of protected plant or animal species: Possible seasonal presence of Red-tailed tropicbirds, Great frigatebirds, Black noddies and White terns during nesting season. All of these bird species are protected under the Migratory Bird Treaty Act.

Description of on site mitigation: The U.S. Fish and Wildlife Service requires that the procedures outlined in section 3.4.1.6 of the Starbird Project Environmental Assessment be followed, with the addition that the survey to be conducted just prior to commencement of construction, be performed by a qualified wildlife biologist.

Site: Telemetry Site

Proposed action: *Prepare telemetry site*
Grade area for 380 foot access road and telemetry site (total area about 0.75 acre).

Current use of land: None

Level of existing disturbance: No existing disturbance

Unique shoreline, intertidal or wetland area: *None present*

General description of plant and animal populations: The following plant species are found at this site:

Beach heliotrope, (Tournefortia argentea)
Shrub, (Pemphis acidula)
grass, (Lepturus repens)

Patches of bare ground were also noted at this site.
There were no birds seen at this site and there was no evidence of recent nesting in this area. See photo 12.

Seasonal presence of animal species of special concern: The type of vegetation present could provide suitable nesting habitat for Red-tailed tropicbirds (Phaethon rubricauda) and Brown noddies (Anous stolidus). Whether these species choose to nest in this area was not determined due to the fact that the survey did not coincide with their nesting season. This area also contained habitat that could be used as nesting habitat for Sooty terns (Sterna fuscata). This species was nesting elsewhere on the atoll at the time of the survey and has not been known to nest in this area.

Presence of protected plant or animal species: Possible seasonal presence of Red-tailed tropicbirds and Brown noddies during nesting season. These birds are protected under the Migratory Bird Treaty Act.

Description of on site mitigation: The U.S. Fish and Wildlife Service requires that the procedures outlined in section 3.4.1.6 of the Starbird Project Environmental Assessment be followed, with the addition that the survey to be conducted just prior to commencement of construction, be performed by a qualified wildlife biologist.

Site: MRTS Site

Proposed action: Prepare site for MRTS instrumentation vans.
Clear and grade an area of about 0.5 acre.

Current use of land: Open grass field

Level of existing disturbance: No existing disturbance

Unique shoreline, intertidal or wetland area: None present

General description of plant and animal populations: Open grass field.
No other plant or animal life present. See photo 13.

Seasonal presence of animal species of special concern: None

Presence of protected plant or animal species: None

Description of on site mitigation: None required

Summary of Results:

Most of the project sites contain very similar habitat; shrubs and small trees interspersed with grass and bare ground. This type of habitat could provide nesting areas for a number of migratory seabirds known to nest on the atoll. The following seabirds have been found to nest in habitat similar to that described above at various locations around the atoll:

Tree and shrub nesters: Great frigatebird (Fregata minor)
Red-footed booby (Sula sula)
Red-tailed tropicbird (Phaethon rubricauda)
Black noddy (Anous Minutus)
White tern (Gygis alba)

Grass and bare ground nesters: Brown booby (Sula leucogaster)
Masked booby (Sula dactylatra)
Brown noddy (Anous stolidus)
Sooty tern (Sterna fuscata)

No birds were found to be nesting in or around the Starbird Project sites at the time of the survey. It is very possible that these areas are used for nesting by some of the above species at other times of the year. Red-tailed tropicbirds are the species that would be most likely be affected by the proposed construction. Previous trips to Wake by this office and others found Red-tailed tropicbirds to be nesting during the months of March and July. No sign of Red-tailed tropicbird nesting was observed during this most recent trip. Nesting patterns of these birds are thought to be highly variable and from the data collected to date, it is not possible to predict what time of year they will start nesting.

Four of the above eight seabird species were found to be nesting at the time of the survey at locations other than the Starlab Project sites. These birds were the Red-footed booby, Brown booby, Masked booby and Sooty tern. They were nesting at various locations on Peale and Wilke's Islands.

In addition to the naturally occurring migratory seabirds, a number of introduced animals were also observed. Rats were seen on Wilke's Island and rat-predated Sooty tern eggs were seen on Peale as well as Wilke's Island. All three islands have large populations of feral cats and a number of people on Wake Island keep cats as pets. Many freshly killed and partially eaten Sotty tern chicks were observed around the nesting colonies, and the bones of at least two bird spieces were found in abandoned buildings. See photos 14 and 15. Two dogs were noted, one is a pet and the other feral but both roam the islands at will. A chicken coop with 14 chickens and a pigeon coop with 28 pigeons was also found.

Recommendations:

Starbird Project sites:

The U.S. Fish and Wildlife Service finds no reason why construction of the proposed facilities should not take place as long as the recommendations made in this report are followed. A careful examination of the project sites by a qualified wildlife biologist, one to two weeks prior to the start of construction and the strict adherence to the procedures outlined in section 3.4.1.6 of the Starbird Project Environmental Assessment for dealing with any nests found, should minimize impact on any nesting species in or around the project sites. In addition, because the sites for the Starlab Project provide potential habitat for nesting migratory seabirds, sufficient habitat within Wake Atoll should be provided exclusively for migratory birds through establishment of protected areas.

Other mitigation:

The addition of the construction crew (40 people) and operating personnel (75 people) to the population of Wake Island will undoubtedly cause increased disturbance to wildlife populations. In addition to this, there is a remote possibility that the expended first stage of the Starbird vehicle could land in a colony of nesting seabirds or that the light and noise generated by the launch of a Starbird vehicle could adversely affect nesting seabirds. Along with these factors is the constant predation pressure caused by the rats and cats, the disruption caused by dogs and the possible transmission of diseases by the chickens and pigeons. To mitigate these effects, it is recommended that a Fish and Wildlife Management Plan be produced, detailing management objectives and methods for preserving and enhancing fish and wildlife resources on all three islands of the Wake Island atoll. We recommend that this effort occur during FY 1990.

Photo 1. Missile Assembly Building (Bldg.1644).

Photo 2. Missile Storage Building (Bldg. 1607).

Photo 3. Barracks Buildings (Bldgs. 1175 & 1176).

Photo 4. Payload and Launch Support Building (Build. 1601).

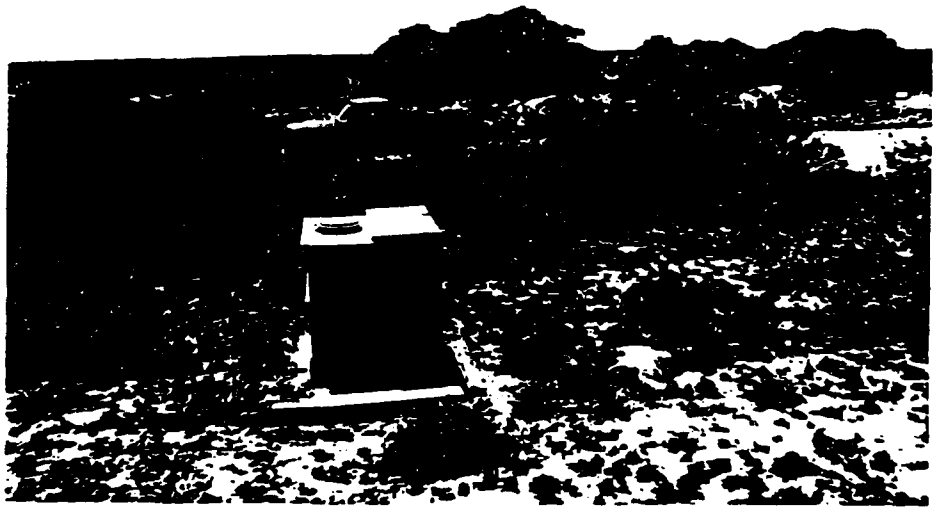


Photo 5. Launch Site No. 1.

Photo 6A. Launch Site No. 2.

Photo 6B. Launch Site No. 2.

Photo 7. Wind Tower.

Photo 8. Pyrotechnic Storage Building (Build. 1642).

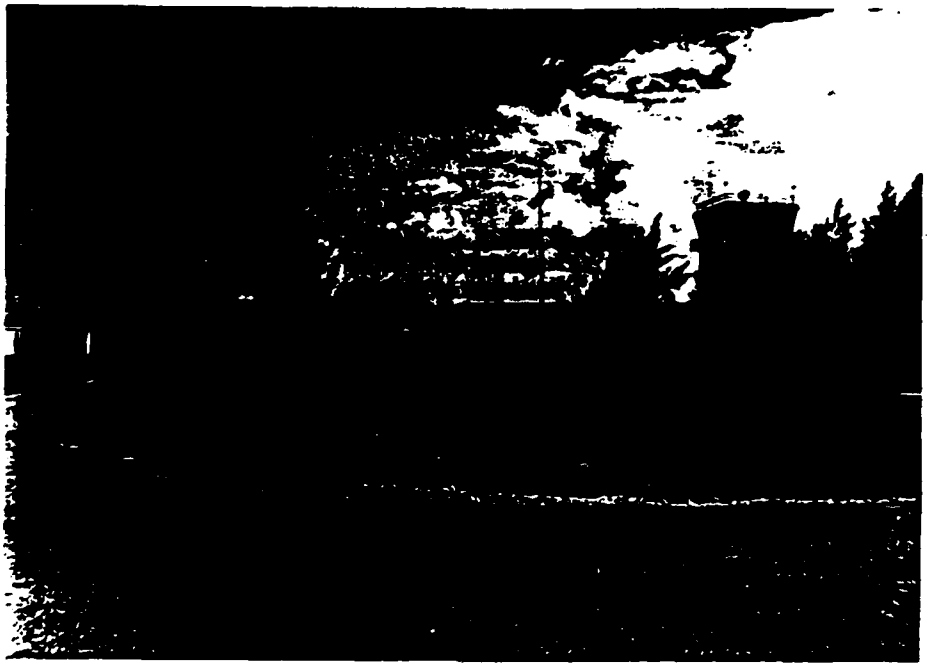


Photo 9. West Guardhouse Site.

Photo 10. East Guardhouse Site.

Photo 11. Radar Site.

Photo 12. Telemetry Site.

Photo 13. MRTS Site.

Photo 14. Cat-predated Sooty tern chick.

Photo 15. Bird bones found in abandoned bunker.

APPENDIX B

TRIP REPORT–WAKE ATOLL (APRIL 4-11, 1989)

United States Department of the Interior
FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS OFFICE
P.O. BOX 50167
HONOLULU, HAWAII 96850

TAKE PRIDE IN AMERICA

June 1, 1989

Dr. Robert Reed
Environmental Sciencesd Division
Oak Ridge National Laboratory
P.O. Box 2008
Oak Ridge, Tennessee 37831-2008

Dear Dr. Reed,

Enclosed is a report of the wildlife present on Wake Atoll during my visit there in April. This is the report that Stewart Fefer mentioned in his letter of April 27. It covers areas other than the proposed Starlab Project sites. Copies of this report are being sent to John Edwards and Dan Evans.

If you have any questions or comments, please give Stewart Fefer or myself a call at (808) 541-1201.

Sincerely,

Craig Rowland

Craig Rowland
Biological Technician

TRIP REPORT - WAKE ATOLL
April 4 - 11, 1989

by
Craig M. Rowland

INTRODUCTION:

The primary goal of this trip was to conduct a survey of proposed construction sites for the Starbird Project. The Starbird Project is a planned test of Strategic Defence Initiative (SDI) technology using a laser shot from the space shuttle to track the launch of a land-based missile. The construction sites surveyed on this trip were proposed launch sites and other support facilities. Funding for this survey was provided by the Air Force and the results will be used to complete an environmental assessment of the project. Detailed results of the project site survey can be found in a separate report entitled 'Biological Survey of Starbird Project Sites'.

In addition to the above work, a complete survey of the animal life atoll was conducted and the results are reported herein.

The results of a survey of the marine habitat will be compiled in a report by Eugene Nitta of the National Marine Fisheries Service

This reported may be cited as: Rowland, Craig M., 1989. Spring Survey of Wake Atoll. U.S. Fish and Wildlife Service Administrative Report.

PERSONNEL:

Craig Rowland, Biological Technician - USFWS
Eugene Nitta, Fishery Biologist - NMFS

ITINERARY:

April 4:	0710 Leave Hickam AFB via MAC flight.
April 5:	1450 Wake time arrive Wake after stopping at Kwajalein enroute.
April 6:	Taken on tour of Wilkes and Wake Islands by Lt. Bryan Scott, USAF. Started survey of Starbird project sites.
April 7:	Conducted complete survey of Peale Island.
April 8:	Conducted surveys of marine habitat in area south of harbor and areas inside edge of the western side of the atoll reef, between Wilkes and Peale Islands.
April 9:	Conducted complete survey of Wilkes Island and completed surveys of Starbird project sites.
April 10:	Worked on report and photographed Starbird project construction sites.
April 11:	Worked on report and surveyed abandoned housing and golf course areas for nesting seabirds.
April 12:	1000 Depart Wake Island on Air Force KC-10.
April 11:	1645 Honolulu time arrive Hickam AFB.

SURVEY METHODS:

All seabirds known to nest on Wake Atoll were searched for. Individual nests were counted for the following species: brown booby, masked booby and red-footed booby.

The number of nesting sooty terns was calculated by pacing off the area of the colony, estimating the percent of this area occupied by adults and chicks and estimating the density of coverage. Most of the chicks could fly, so it was not possible to get an accurate measure of density; an estimate had to be made. The sooty tern colonies of Peale Island were particularly difficult to estimate due to the patchy distribution of birds caused by trees and irregular topography. An even more difficult colony ot estimate was the colony inland of Flipper Point on Peale Island. The shape of the colony was so irregular and the birds (chicks and adults) so flighty, that it was not possible to pace off the circumference of the colony without all the birds taking flight.

Peale and Wilkes Islands were surveyed by walking back and forth across the islands so that the entire area was covered. Sooty tern colonies were circumnavigated. Wake Island was surveyed by driving as much of the island as possible and walking through areas not accessible to automobiles.

RESULTS:

Peale Island:

Sooty tern Sterna fuscata

Sooty terns were the only nesting birds observed on Peale Island. They were found on Flipper Point (100,000 chicks estimated), in an area inland of flipper point (3,000 chicks estimated) and in an area north of the road, just west of the first beach house area (40,000 chicks estimated). These areas are marked A, B and C respectively on the map (figure 1.). As stated in the methods section, the sooty tern colonies of Peale Island were difficult to estimate due to the uneven distribution of birds and the fact that almost all the chicks were able to fly, making density measurements impossible. Keeping these conditions in mind, the figures mentioned above should be thought of as very rough estimates. About 60 adult sooty terns were seen roosting on a small sand island, off the tip of Toki Point. This islet was investigated and no nests were present.

Other bird species:

The following species were seen on Peale Island but were not nesting.

Brown noddy Anous stolidus - 18 roosting on a structure offshore, northwest of Flipper Point.

Red-tailed tropicbird Phaethon rubricauda - Birds seen in courtship flight, three on windward side of island, two near Flipper Point.

White tern Gygis alba - Four flying around the tops of ironwood trees.

Great frigatebird Fregata minor - Seven juveniles seen flying overhead.

Wandering tattler Heteroscelus incanus - Two seen feeding along the shoreline.

Feral cat Felis catus

Cat tracks and droppings were seen near the sooty tern colonies. There are many abandoned structures on Peale Island that are sure to provide good cover to feral cats.

Hermit crabs

These large orange hermit crabs were seen in great numbers all over the island. They were usually found in abandoned structures or at the base of large trees. Under one Pisonia tree (Pisonia grandis), 20 hermit crabs, two to three inches across were found in an area of about one square meter.

Wake Island:

Wake Island is the most developed island of the atoll and the island with the most human activity. This might account for the paucity of nesting birds here. In spite of the human activity, much of the habitat appears to be suitable for red-tailed tropicbird and white tern nesting. These species were not nesting at the time of the survey, so it is unclear if this habitat is utilized.

The dump at Peacock Point is in an area exposed to strong winds, and due to minimal coverage of refuse, provides good opportunities for plastic debris to blow into the ocean (see photograph 2).

Pigeons Columba livia - The only nesting birds found on Wake Island were pigeons that were being kept as pets by some of the contract employees. 28 adult pigeons were observed roosting on a pigeon coop from which the sound of begging chicks could be heard (see photograph 3).

Chicken Gallus gallus- At the same house, 14 chickens were found living in a pen.

White tern Gygis alba - White terns were seen flying around ironwood trees at many locations on the island, but no nests were found and no courtship behavior was observed.

Laysan albatross Diomedea immutabilis - Two laysan albatross were seen and photographed flying over Peacock Point. The area where a Laysan albatross nest was said to have been located last year, was investigated but no signs of a nest were seen. A map of this location can be found in figure 2 so that on future trips, this area can be surveyed for any sign of nesting. A photograph in the Wake Island Museum, of the old Pan Am Hotel in 1936, shows an adult laysan albatross and a number of downy albatross chicks on the lawn.

White-tailed tropicbird Phaethon lepturus - one seen in flight near the west end of the runway.

Red-tailed tropicbird Phaethon rubricauda: - Four birds were seen in courtship flight over the missile storage building near Peacock Point.

Lesser golden-plover Pluvialis dominica - Lesser golden-plovers were abundant at the many open grass fields on this island.

Feral cat Felis catus
Quite a few cats were seen on Wake Island. Cat food as well as dog food is sold in the local store and many people keep cats as pets or feed feral cats.

Dog Canis familiaris
There are two dogs on Wake, one is a pet and the other feral, but both are free to wander the atoll at will.

Wilkes Island:

Sooty terns, brown boobies, red-footed boobies and masked boobies were found to be nesting on this island.

Sooty tern Sterna fuscata

Sooty terns were nesting in the vortac field at the west end of the island. They occupied an area (estimated by pacing two sides of the colony) of approximately 48,000 square meters. Similar to the sooty terns on Peale Island, the chicks on Wilkes had fledged or were about to do so. They all could either fly or run away if approached, making an accurate measurement of density difficult. A rough estimate of 250,000 chicks was made.

Brown booby Sula leucogaster

Brown boobies were nesting around the western perimeter of the vortac field at the west end of Wilkes. A total of 106 nests were found in three groups with a few nests scattered between the groups (see figure 3). The contents of these 106 nests were:

- 13 - eggs (either 1 or 2 per nest)
- 2 - chicks with down just appearing on back (stage 2)
- 7 - chicks with down beginning to cover entire body (stage 3)
- 12 - chicks all downy, approximately half adult size (stage 4)
- 19 - chicks all downy, approximately adult size (stage 5)
- 25 - chicks with primaries and retrices visible, scapulars not present (stage 6A)
- 28 - chicks with scapulars visible and down still present on back (stage 6B)

Masked booby Sula dactylatra

Two masked booby nests were found at the northwest perimeter of the vortac field (see figure 3). One contained a stage 6B chick (scapulars visible and down still present on back) and the other a stage 9 chick (fully feathered).

Red-footed booby Sula sula

A total of 41 red-footed booby nests were present in the tournefortia trees at the northeast edge of the vortac field (see figure 3). Of these 41 nests, three were stage 4 (all downy, approximately half adult size), two were stage 5 (all downy, adult size) and the contents of the remaining nests were unknown due the fact that they were located high in the trees and no chick could be seen in the nest. It is assumed that these nests contained eggs or small chicks that were not visible beneath the adult on the nest.

Great frigatebird Fregata minor

40 great frigatebirds were seen roosting near the red-footed boobies and flying overhead. Approximately 30 of these birds were juveniles. No nests were seen.

Feral Cat Felis catus

Many freshly killed sooty tern chicks were found in various locations throughout the colony. These were undoubtedly killed by feral cats (see photograph 4). Cat tracks and droppings were observed around the colony and the bones from at least two different species of birds were found in abandoned bunkers. A healthy kitten was seen running through the vegetation on the perimeter of the colony.

Rats

A rat was seen in the Tribulus of the vortac field and rat predated sooty tern eggs were found nearby.

RECOMMENDATIONS:

The problems caused by introduced species need to be given attention to avoid possible depletion of wildlife populations. A naturally occurring downswing in a population, combined with the stress caused by introduced species could have dramatic results. The stress caused by introduced species is in the form of constant predation pressure by cats and rats, disruption caused by dogs and possible transmittion of diseases by chickens and pigeons. It is recommended that a Fish and Wildlife Management Plan be produced for Wake Atoll. This plan would address objectives and methods for preserving and enhancing fish and wildlife resources on the atoll. It is recommended that this plan be produced in FY 1990.

Photo 1. Wake Atoll.

Photo 2. Peacock Point Dump.

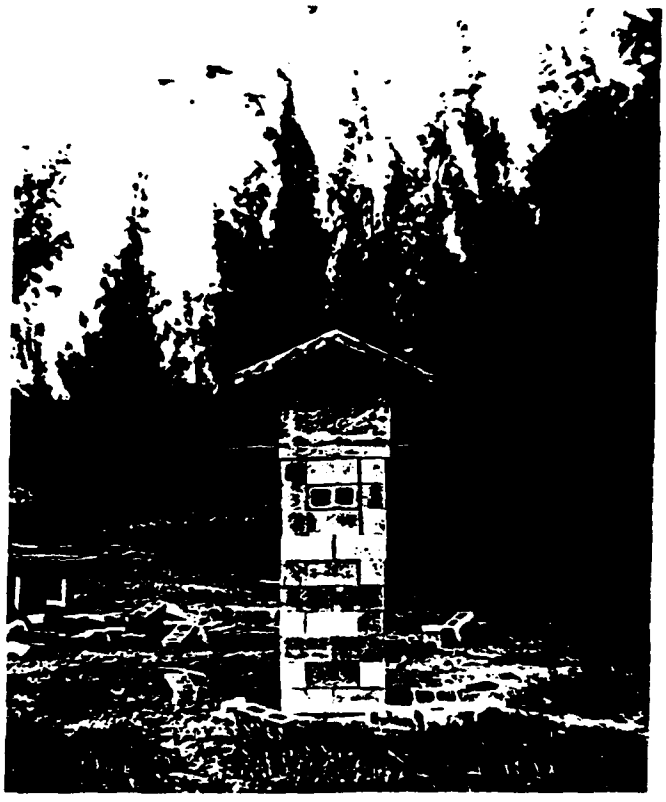


Photo 2. Pigeon coop (foreground) and chicken coop (background).

Photo 4. Cat predated sooty tern on Wilkes Island.

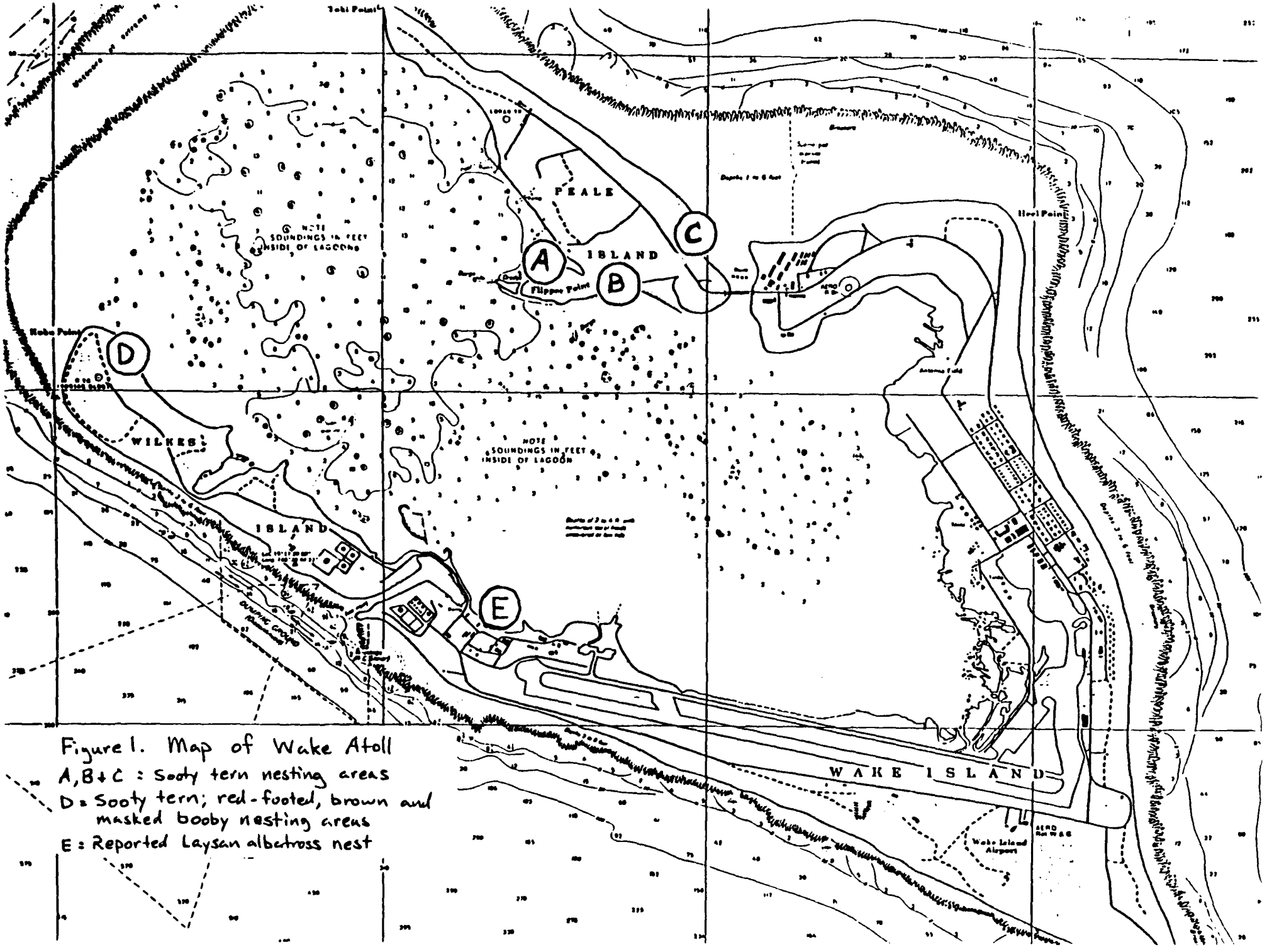


Figure 1. Map of Wake Atoll

A, B + C : Sooty tern nesting areas

D = Sooty tern; red-footed, brown and masked booby nesting areas

E = Reported Laysan albatross nest

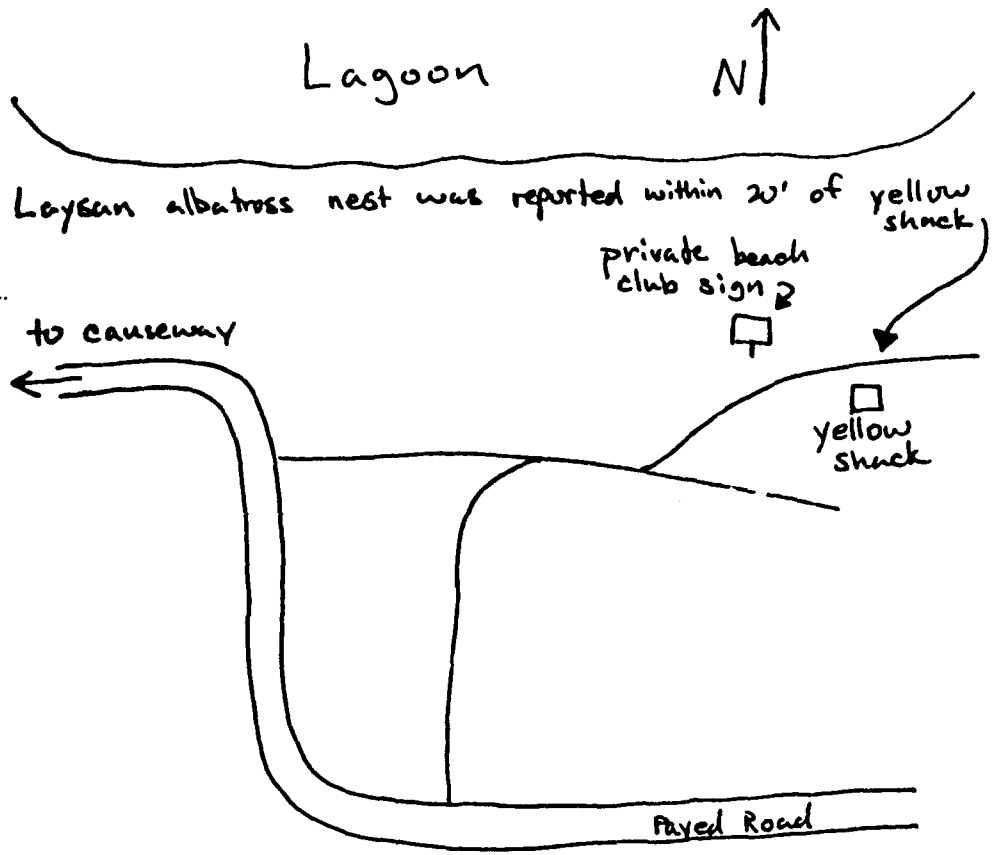


Figure 2. Location of reported Laysan albatross nest on Wake Island. See location E on figure 1.

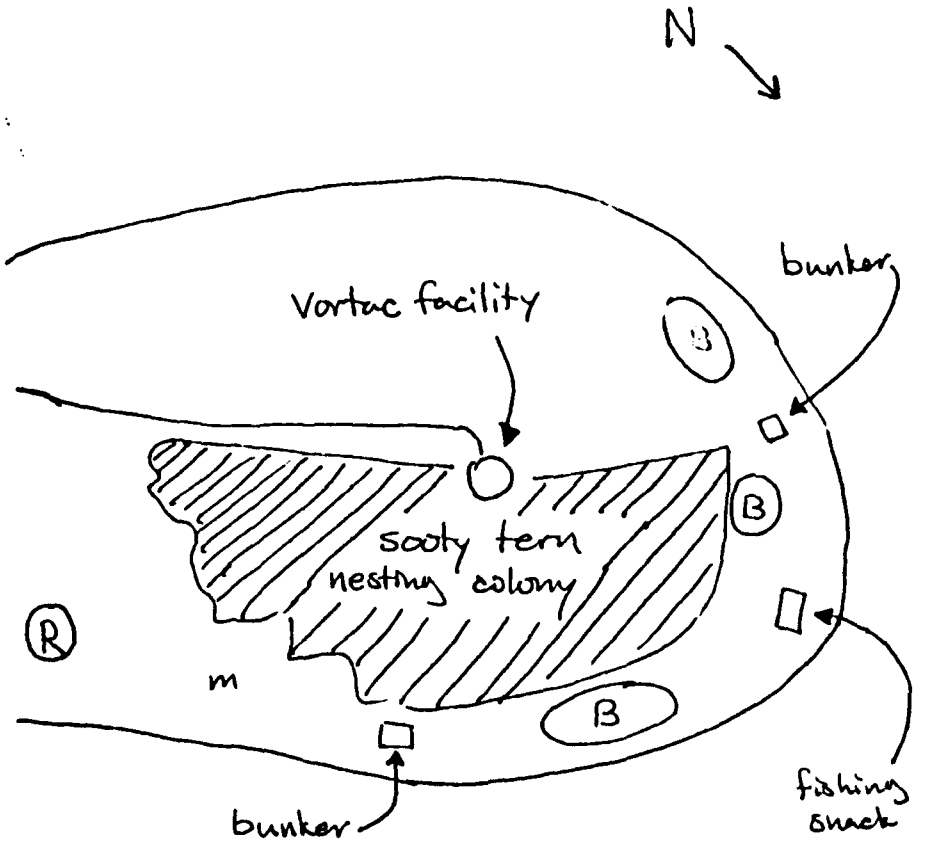


Figure 3. Locations of nesting seabirds at vortac field on Wilkes Island. See location D on figure 1.
m = masked booby nest
(B) = brown booby nesting colony
(R) = red-footed booby nesting colony

APPENDIX C

SEA TURTLE ASSESSMENT AT WAKE ISLAND

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region • Pacific Area Office
2570 Dole St. • Honolulu, Hawaii 96822-2396

May 5, 1989 F/SWR14:ETN

Mr. John R. Edwards
U.S. Air Force Space Division/DEV
P.O. Box 92960
Los Angeles AFB, CA 90009-2960

Dear Mr. Edwards:

Enclosed is the Trip Report/Sea Turtle Assessment for Wake Island as requested by the U.S. Air Force to aid in preparation of the Environmental Assessment for the STARLAB program. One original and 20 copies are provided. One copy with photographs has been sent directly to Mr. Rob Reed at the Oak Ridge National Laboratory per your instructions. Although a one time survey can produce only limited information, it should assist the U.S. Air Force in their environmental evaluations and provide the basis for any future turtle assessment work at Wake Island. Please call me at (808) 955-8831 if there are any questions.

Sincer ly yours,

Eugene T. Nitta

Eugene T. Nitta
Protected Species Branch

Enclosure

cc: Mr. Rob Reed, ORNL (w/enc.)

SEA TURTLE ASSESSMENT AT WAKE ISLAND

Prepared for the U.S. Air Force Space Division/DEV
in support of the STARLAB Program

Eugene T. Nitta
Protected Species Management Branch
Pacific Area Office
Southwest Region
National Marine Fisheries Service

May 1989

SEA TURTLE ASSESSMENT AT WAKE ISLAND

Introduction

During early discussions concerning the potential environmental impacts of the Starbird Project at Wake Island, the presence of listed sea turtles at Wake Island was pointed out to the U.S. Air Force and U.S. Army. On the basis of available information it could not be determined whether or not consultation under the Endangered Species Act of 1973, as amended, would be be required for the proposed Starbird Project. After reviewing environmental assessments developed by the U.S. Air Force and U.S. Army for Starbird, NOAA Fisheries recommended that an on-site inspection be conducted at Wake Island to attempt to document the presence of listed sea turtles, and the availability of suitable forage and nesting beaches.

To carry out the recommended survey, the U.S. Air Force provided transportation and per diem costs for a biologist from NOAA Fisheries to travel to Wake Island during the same time as a biologist from the U.S. Fish and Wildlife Service (FWS) was to conduct migratory seabird surveys. This work was conducted at Wake Island from April 5 through April 11, 1989. Support was provided by Detachment 4, 15th Air Base Wing, Hickam Air Force Base and Intelcom, the service contractor for Wake Island.

Background

Wake Island is a coral atoll, located midway between Guam and Hawaii at lat 19°18' N, long 166°38' E (Bryan 1959; Banner et al. 1969; Gooding 1971; Figure 1). The atoll consists of three

islets, Wake, Wilkes, and Peale, with a total land area of approximately 6.5 km² (2,600 acres). The use of Wake here refers to the entire atoll, while Wake Island will refer to the islet. All of the islets are connected by bridges or causeways. Wake Island proper is the largest of the three islets with a 10,000 foot long runway, refueling and support facilities, and quarters for the civilian contractor workforce and U.S. Air Force administrators (Bryan 1959). The three islets form a "V" with the open end facing northwest enclosed by a reef (Figure 2). The atoll is about 7.2 km long from northwest to southeast and about 3.2 km wide. The total area of the lagoon is about 9.1 km² with a maximum depth of about 3-4 m (Gooding 1971).

Wake has a long and interesting history, from its initial recorded discovery in the 16th century through its role in World War II. It is well documented in other sources and reference should be made to them for detailed information (Bailey 1951; Bryan 1959).

Physical Description

Wake is a typical coral atoll with a fringing reef surrounding a lagoon and three major islets enclosing the lagoon on two sides. The reef fronting the islets is composed of the typical structures of a tropical coral reef including the outer slope, reef front, and outer and inner reef flat. The intertidal zone is characterized by raised platforms of consolidated limestone, behind which the seaward beach begins.

The reef which closes off the lagoon to the northwest is wide and has no passage for even a small boat. The reef is wider on the north and northwest and narrowest on the south of the atoll. The northeast trades promote high energy wave action on the east and northern faces of the reef.

Beaches

The composition of seaward beaches range from a combination of hard limestone benches and medium sized limestone cobble to fine coral sand. The lagoon beaches are coral sand or limestone cobble interspersed with spurs and points of hard raised limestone. Extensive, shallow sand flats characterize the inner lagoon shoreline at the base of the "V" of Wake.

The seaward beaches were surveyed by walking the perimeter of the islands. Beginning at Toki Point on Peale Island, the beach at the Point consists of coral sand grading into small gravel and larger cobble moving southeast toward Wake Island. The beach slope also becomes steeper. Just before the vegetation line begins at the beach crest there is a zone of small coral rubble that appears to be deposited by storm surge. The beach crest is usually covered with grass interspersed with shrubs and trees such as heliotrope (Tournefortia argentea), naupaka (Scaevola sericea), and beach morning glory (Ipomea tuba) (Fosberg 1959). About midway along the north shore of Peale Island there is a concrete seawall at the beach crest, approximately 200-250 m long. The beach here is characterized by a raised limestone bench backed by a cobble beach. From the end of the seawall to the bridge between Peale and Wake Islands the beach becomes

sandier with less cobble and coral rubble. A wide sandy inlet and beach just before the bridge with scattered ironwoods (Casuarina sp.), inland appears to be suitable for turtle nesting if high enough out of the high tide line. Further east, closer to Wake Island, fishing shacks have been built on the shoreline by the residents of Wake. There is a sandy beach along the margin of the channel between Wake and Peale Islands. A wide sandy shoal fronts the channel and is exposed at low tide. The coral sand beach gives way to a coral rubble beach of small to medium sized cobble. The beach slope increases in steepness toward Heel Point on Wake Island. The beach crest is vegetated with grass, naupaka, heliotrope, and ironwood.

The intertidal zone is characterized by a hard, consolidated limestone bench, raised in some areas with boulders scattered on the bench and reef flat. From Heel Point southeast toward Peacock Point, the beach consists mostly of small limestone rubble over sand. The intertidal zone is dominated by a raised limestone bench, undercut on the landward side of the beach. Where there are breaks in the bench, open patches of sandy beach occur, particularly opposite the abandoned antenna field. From Peacock Point to the NOAA weather instruments, the beach consists of a hard black limestone bench backed by a rubble beach. A concrete revetment runs about half the length of the runway up to the tank farm at the end of Wake Island.

The beach from the harbor channel to the submarine channel is much the same as along the south shore of Wake Island. A hard,

blackened, limestone intertidal bench, uneven in many areas with storm-deposited limestone boulders and horizontal and parallel cuts characterize this section of beach. The upper beach consists of coral sand and small coral rubble up to the beach crest. Where it exists, the vegetation is similar to the rest of the atoll. The reef flat here is very narrow in comparison to other areas of the atoll. A few of the isolated coral heads offshore of the reef face appear to have some macroalgal growth, but the species or percentage cover could not be determined. At Kuku Point the upper beach consists of coral rubble; the intertidal zone and reef flat is characterized by limestone boulders overlaying a hard irregular limestone bench. The width of the reef flat narrows considerably from west to east. From Kuku Point on Wilkes Island to Toki Point on Peale Island, a wide reef closes the lagoon.

In general the lagoon beaches of the three islets are sandier and less rocky than the seaward beaches. On Wilkes Island and Wake Island some rocky outcroppings and scattered boulders with cobble beaches occur. The beaches on the lagoon side of Peale Island are composed mostly of coral sand and small-sized coral rubble. The slopes are generally not steep and grade into a vegetation with no discernible beach crest on Peale Island. Some of the beach areas on Flipper Point and near the old Pan Am Hotel site might be suitable for green turtle nesting because of the composition of the sand/humus substrate.

On Wilkes Island the lagoon beaches face windward and have fairly steep slopes accentuated by wartime modifications such as berms

and tank traps. The unfinished channel shows evidence of wave erosion quite high up on the shore on the lagoon side. None of the areas surveyed on the lagoon side of Wilkes Island or Wake Island appear to have the requisite factors for turtle nesting.

Sea Turtle Resting Habitat

Resting habitat for green turtles is generally found in proximity to their foraging areas, often within 1,000 m or less. These underwater sites include coral recesses, the undersides of ledges, depressions on the bottom, and caves, that are generally free of strong currents or tidal action. In Hawaii these resting areas are usually found in waters >20 m, but probably not deeper than 50 m (Balazs 1980). On the southern edge of the atoll at Wake Island the reef face drops off to a short sand shelf at about 8 to 10 m, beyond which, the bottom drops off steeply to oceanic depths. It appears that any turtle resting habitat would be associated with the structures of the outer reef face and deeper patch reefs. Strong wave and swell conditions precluded small boat surveys of the reef on the windward side of the atoll during this trip.

Sea Turtle Food Sources

Samples of macroalgae were collected from around Wake Island atoll during the beach surveys and during small boat surveys to the south shore and in the lagoon. The diversity and biomass of macroalgae at Wake in general appears to be much lower than in areas such as the Hawaiian Islands or the the northern Marshall Islands (Taylor 1950; Balazs 1980). Fleshy green and red-brown

algae are almost nonexistent in the intertidal zones of the atoll. The bulk of the growth probably occurs subtidally on the outer reef face and in the spur and groove structures of the reef. The reef flat may also support some growth of genera such as Dyctosphaeria, Halimeda, and Caulerpa (Magruder and Hunt 1979; Table 1.). In Bryan (1959) there is a record of Dyctosphaeria favulosa from Bailey and Harvey (1874) in U.S. Exploring Expedition, Botany Cryptogamia 17:153-192. Of the species collected at Wake during this survey, Caulerpa racemosa and Dictyota acutiloba are the only ones on which green turtles have been reported to feed (Balazs 1980). They were found on the south shore of Wake Island off the outer reef face on a submerged coral head. This area is also where most of the recent turtle sightings for the atoll have been made.

Turtles have also been reported in the lagoon, presumably feeding. A few days before our arrival on Wake a turtle was seen by one of the civilian workers under the bridge between Peale and Wake Island heading seaward. There may be some source of food within the lagoon for turtles such as Caulerpa racemosa on the scattered coral heads, which were not surveyed, but little else. There was no evidence of sea grass or marine angiosperms, which is consistent with observations from the northern Marshall Islands of Rongelap, Rongrik, Bikar, and Taongi (Taylor 1950). High winds and reduced visibility in the water resulted in poor conditions for underwater and boat surveys in the lagoon, and kept observations to a minimum. It should be noted that there is a probable seasonal variation in abundance and distribution of

the algal resources of Wake Island, which a one-time survey cannot address.

Sea Turtles

According to Marshallese tradition Wake was used in the past as a place to collect birds and turtles. The Marshallese refer to it as Enen-Kio (Carter 1984). If turtles were abundant enough to be worth a trip of several hundred miles by canoe to harvest, then the turtle population at some point must have been fairly substantial.

Recent information regarding sea turtles at Wake Island is sparse. Balazs (1979) noted that both immature and mature green turtles (Chelonia mydas) were "...regularly observed foraging in the lagoon and along the outside perimeter of the atoll." During the late 1960's and into the 1970's polished turtle shells were given as gifts to dignitaries and retiring personnel at Wake (G. Balazs, NOAA Fisheries, Honolulu Laboratory, pers. commun.).

Interviews with the current residents of Wake indicate that the sea turtle population at Wake is very small and that nesting does not occur. There is, however, apparently enough forage to support the small number of sea turtles observed around Wake, even accounting for seasonal variation in algal abundance. Individual animals are occasionally seen off the south side of the atoll during fishing trips or while conducting routine maintenance on the mooring buoys. No green turtles were seen during the period of our observations. The endangered hawksbill turtle (Eretmochelys imbricata) may be an occasional visitor, but

there are no confirmed records from Wake and none were observed during this survey.

Marine Mammals

Stranding records and anecdotal accounts of small whales and dolphins from Wake indicate the presence of spinner dolphins (Stenella longirostris) and beaked whales (Ziphius cavirostris). Pacific bottlenose dolphins (Tursiops truncatus gilli) may also occur, but there are no records of this species from Wake. Because of the current configuration of the atoll and entrances into the lagoon it appears unlikely that any small cetaceans could easily enter the lagoon. An endangered Hawaiian monk seal (Monachus schauinslandi) was observed hauled out on the south shore of Wake Island in 1987. The animal had been tagged as a weaned pup in 1984 at Pearl and Hermes Reef, Northwestern Hawaiian Islands. It has not been seen since that initial sighting (Doris Alcorn, NOAA Fisheries, Auke Bay Laboratory, pers. commun.)

Other Marine Species

The species composition of marine fish and invertebrates found at Wake is probably similar to that found at the northern atolls and islands of the Marshall Islands. A list of fish families and species identified at Wake during the grounding of the tanker, R. C. Stoner and subsequent oil spill is provided in Table 2. Surveys conducted in 1967 found the highest diversity and greatest number of fish on the outer reef face, and that the lagoon supported a large population of fish (Gooding 1971). A brief snorkel survey of the R. C. Stoner wreck site and the outer

reef face reconfirmed these earlier observations.

Summary and Conclusions

While this extremely limited survey in no way provides a definitive description of green turtle foraging and resting habitat and potential nesting habitat, traditional Marshallese lore indicates that some level of abundance sufficient to support a subsistence harvest was present at one time. There is no evidence of such a population now or in the recent past. Although speculative, overharvesting of turtles for food by Japanese bird poachers for the far east millinery trade at the beginning of the twentieth century may have reduced the turtle population considerably. Had there been any historic nesting sites on any of the islets at Wake, extensive habitat modification to accommodate and support early transpacific flying boat service in the 1930's and later, wartime construction and destruction during World War II would have essentially rendered it unusable by turtles. Remaining areas that may be potential nesting sites are used now extensively for recreational activities. The turtles currently found at Wake appear to be just a small remnant foraging population of relatively young animals.

As described in the "Preliminary Draft Description of Proposed Starlab Experiment and Maps of Proposed Construction" sites for the Starlab Project at Wake are sufficiently inland and removed from any potential sea turtle habitat (Figure 3). Except for the highly remote possibility of contact with missile

components from a launch accident, sea turtles are not likely to be affected by the project. The impact of the Starbird Project at Wake Island on the small number of resident individual animals is likely to be negligible.

Any marine mammals that may be found at Wake Island are not likely to be affected by the proposed Starbird Project.

Table 1. Some macroalgae collected at Wake Island.

Dyctosphaeria sp.
Halimeda opuntia
Caulerpa serrulata
Caulerpa racemosa
Dictyota acutiloba
Bornetella sphaerica
Lyngbya sp.(?)

Table 2. Some of the fishes identified from Wake Island (From Gooding 1971).

Serranidae (groupers) - At least two other unidentified species
- *Cephalopholis argus*

Holocentridae (squirrelfish)
- *Holocentrus lacteoguttatus*

Scaridae (parrotfishes) - At least two other unidentified species
- *Scarus perspicillatus*
- *Scarus sordidus*

Mullidae (goatfish) - Unidentified

Acanthuridae (surgeonfishes)
- *Acanthurus achilles*
- *Acanthurus nigricans*
- *Acanthurus triostegus*
- *Ctenochaetus striatus*
- *Zebrasoma flavescens*
- *Zebrasoma veliferum*

Chaetodontidae (butterflyfishes)
- *Centropyge flammeus*
- *Chaetodon lunula*
- *Chaetodon semeion*

Balistidae (triggerfishes)
- *Melichthys vidua*
- *Rhinecanthus rectangulus*

Scorpaenidae (scorpionfish)
- *Pterois volitans*

Diodontidae (puffer)
- *Diodon hystrix*

Muraenidae (moray) - Unidentified

Mugilidae (mullets) - Unidentified

Pomacentridae (damselfishes)
- *Abudefduf imparipennis*
- *Abudefduf sordidus*
- *Pomacentrus nigricans*

Priacanthidae (bigeye scad) - One specimen found unidentified

Cirrhitidae (hawkfish) - Unidentified

Carangidae (jack) - Unidentified

Labridae (wrasse)
- *Thalassoma umbrostigma*

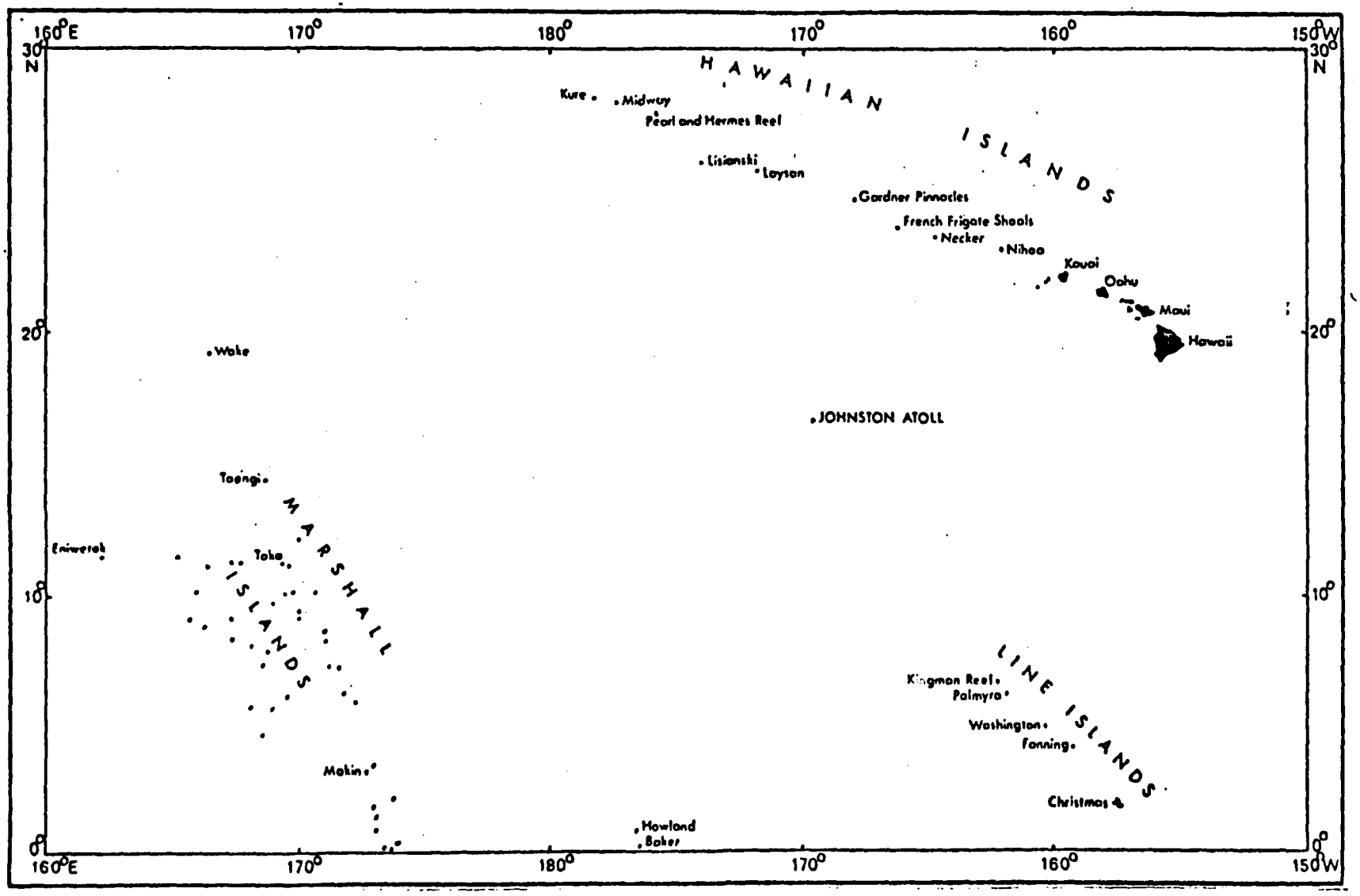


Figure 1. North Central Pacific Ocean (from Amerson and Shelton, 1976).

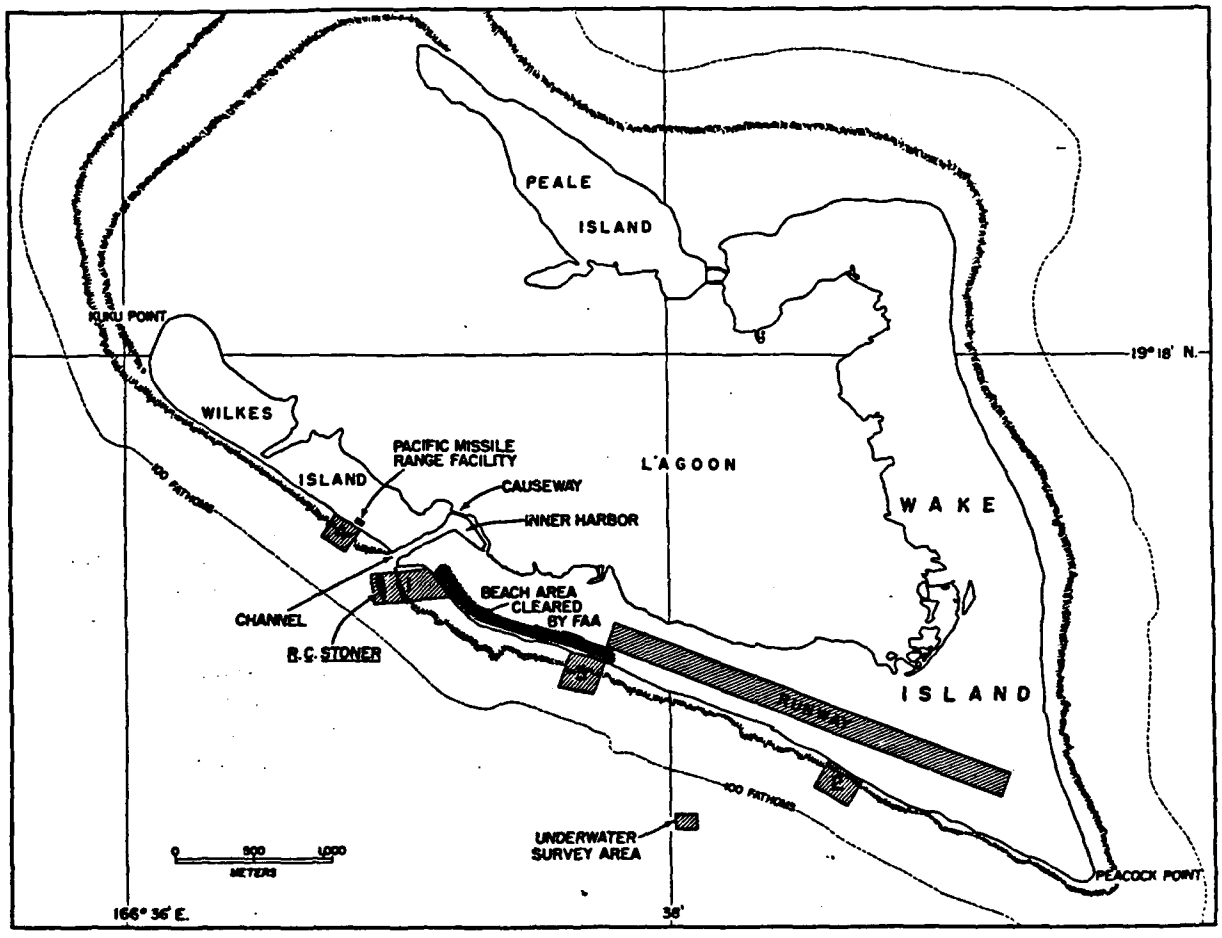


Figure 2.--Wake Island (From Gooding 1971).

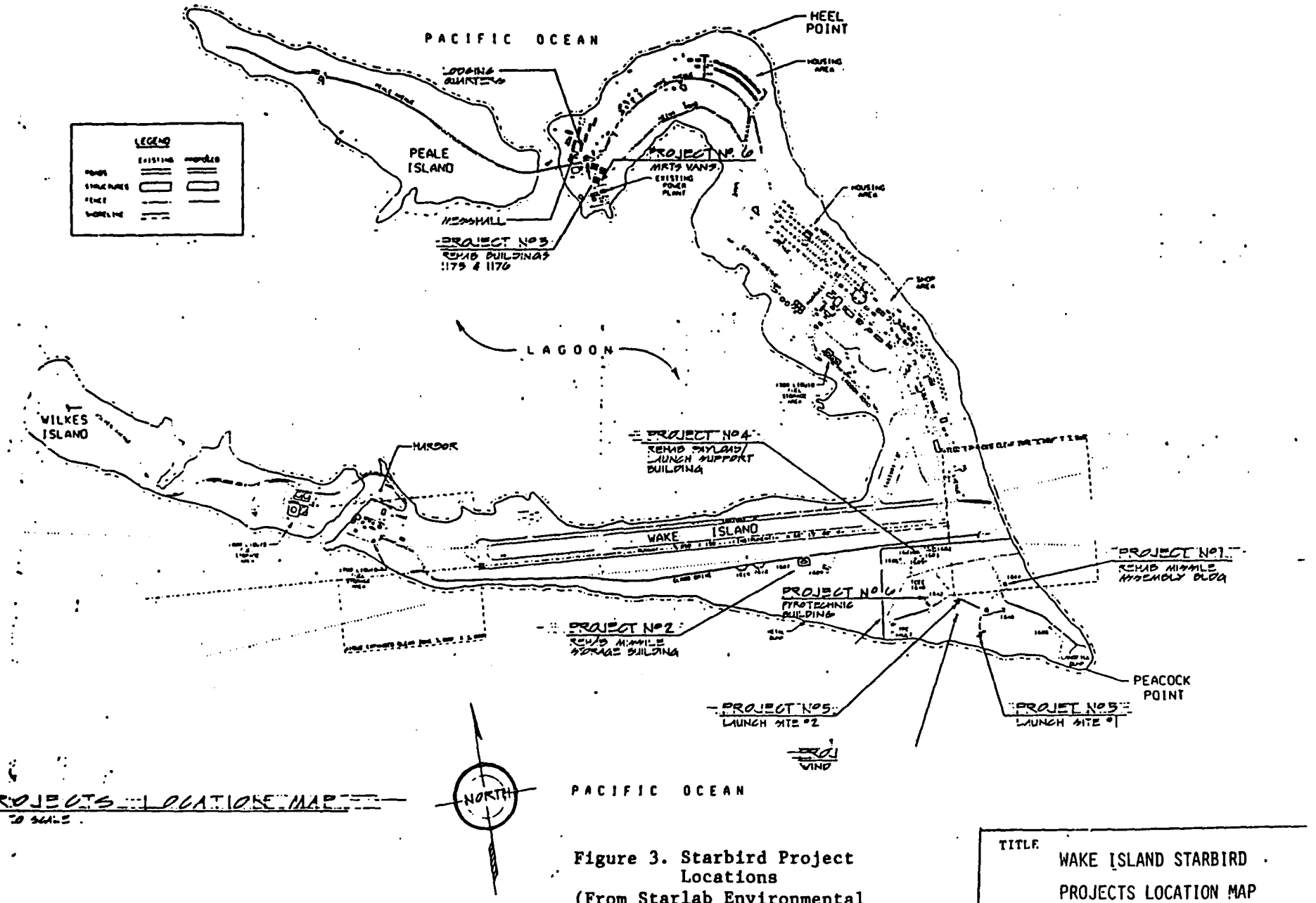


Figure 3. Starbird Project Locations
(From Starlab Environmental Assessment, Chapter 2, Preliminary Draft).

TITLE
WAKE ISLAND STARBIRD
PROJECTS LOCATION MAP

DWG NO.
DWG. NO. 1

FAC DWG TO BILL

Wake Island

Toki Point, Peale Island looking east in the lagoon

North shore of Peale Island looking toward Wake Island

North shore Peale Island south of the seawall

North shore of Peale Island; east end of the island near the sooty tern colony

South side of Peale Island toward Flipper Point from the channel between Wake and Peale

Peale Island near the old Pan Am Hotel site

Causeway and bridge between Wake Island and Peale Island

North shore of Wake Island looking toward the old antenna field

South shore of Wake Island near launch site no. 1

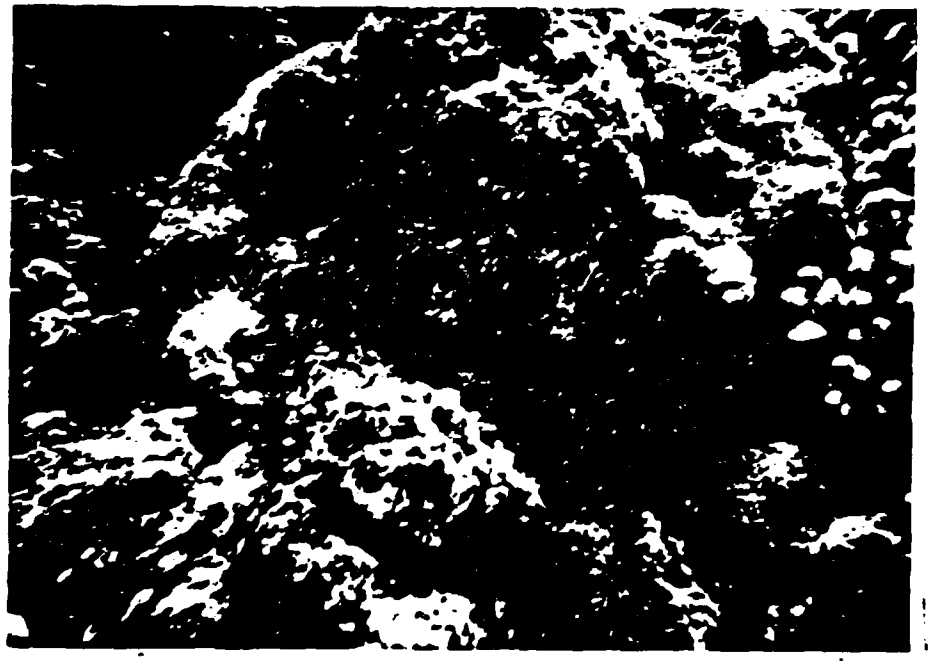
Revetment - south shore of Wake Island

Lagoon side of Wilkes Island at Kuku Point

Lagoon side of Wilkes Island looking toward Starbird radar site and old quarry

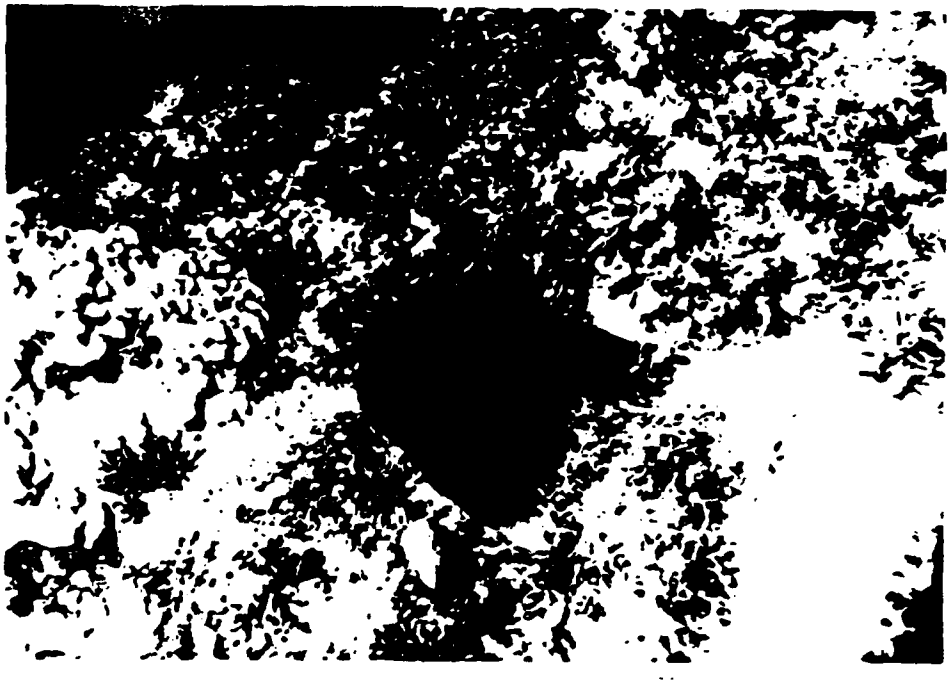
South of Kuku Point, west end of Wilkes Island

Patch of Halimeda opuntia in rocky intertidal, Wilkes Island



Halimeda opuntia growing on coral head near "A" buoy,
east of harbor entrance channel, Wake Island.

Halimeda opuntia and Gymnothorax javanicus from the outer reef face off the south shore of Wake Island



Halimeda opuntia and Caulerpa racemosa from the south side of Wake Island

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APPENDIX D

SEABIRD SURVEY OF PROJECT STARBIRD CONSTRUCTION SITES ON WAKE ATOLL

DEPARTMENT OF THE NAVY
PACIFIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
(MAKALAPA, HI)
PEARL HARBOR, HAWAII 96860-7300

11015.4W
Ser 2432/12256
22 NOV 1989

Mr. Jerry Leinecke
Complex Refuge Manager
Hawaiian and Pacific Islands
U. S. Fish and Wildlife Service
P. O. Box 50167
Honolulu, Hawaii 96850

Dear Mr. Leinecke

Enclosed is a copy of a Memorandum for the File documenting a survey for seabird nesting activities at construction sites for the U. S. Army Strategic Defense Command's Project Starbird on Wake Atoll. The survey was conducted by the Pacific Division, Naval Facilities Engineering Command's Fish and Wildlife Biologist from October 25 to November 1, 1989.

No seabirds were found nesting or using any of the project sites, and there were no wildlife concerns noted that would preclude clearing or construction at any of the selected sites.

Should further assistance or information be required on this matter, PACNAVFACENGCOM's point of contact is Mr. T. Sutterfield at 471-3217.

Sincerely,

J. L. BUSEKRUS
Assistant Head
Facilities Planning Department

Encl:
(1) PACNAVFACENGCOM Memo for the File
11015.4W 2432/5678J of 14 Nov 89

Copy to:
ROICC PEARL (F-2)
OCDRUSASDC (DASD-H-TF) ✓
15ABW (LG, DEEM)
DET 4 15ABW

DEPARTMENT OF THE NAVY
PACIFIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
(MAKALAPA, HI)
PEARL HARBOR, HAWAII 96860-7300

11015.4W
2432/56703
14 Nov 89

MEMORANDUM FOR THE FILE

Via: 243 24

Subj: SEABIRD SURVEY OF PROJECT STARBIRD CONSTRUCTION SITES ON WAKE ATOLL

Ref: (a) Environmental Assessment for Project Starbird of Oct 87

Encl: (1) Wake Atoll Seabird Survey Project Starbird

1. In accordance with reference (a) the subject survey was performed on Wake Atoll from 25 October to 1 November 1989. The sites surveyed as depicted on enclosure (1) were the radar and telemetry sites on Wilkes Island and the missile storage building, the payload launch support building, the pyrotechnic building, the missile assembly building, launch sites one and two, areas to be cleared and grubbed for electrical trenching, buildings 1175 and 1176, and the MRTS site all of which were located on Wake Island.

2. No protected seabird species were located on or within the areas surveyed for the project sites, and there are no fish or wildlife concerns that would preclude clearing or construction at the selected sites. The closest seabird colony to any of the project sites was a red-footed booby (Sula sula) colony located approximately 200 hundred meters west of the radar site on Wilkes Island.

3. An atoll-wide survey was performed to document and map, as depicted on enclosure (1), the seabird colonies on Wake Atoll. The survey findings are summarized as follows:

a. On Wilkes Island, 274 great frigatebirds (Fregata minor) were counted sitting on old power lines crossing the unfinished channel; 148 brown boobies (Sula leucogaster) were beginning construction of nests (two were on eggs); two masked boobies (Sula dactylatra) were on eggs; 48 red-footed boobies were in the beach heliotrope (Tournefortia sp.) (19 fresh nests were occupied); 12 brown noddies (Anous stolidus) were sitting on rocks offshore; and numerous sooty terns (Sterna fuscata) were observed flying overhead. Lesser golden-plovers (Pluvialis dominica) were common in the cleared VORTAC field and a lone cattle egret (Bubulcus ibis) was seen on the western point of the island.

b. On the northwest point of Peale Island, approximately 10,000 sooty terns were present and a few eggs were seen, and three white-tailed tropicbirds (Phaethon lepturus) were seen flying overhead. On Wake Island, the only birds seen were lesser golden plovers in grassy areas around the runways and on the road shoulders, and a lone frigatebird sitting on a power pole near Peacock Point.

Subj: SEABIRD SURVEY OF PROJECT STARBIRD CONSTRUCTION SITES ON WAKE ATOLL

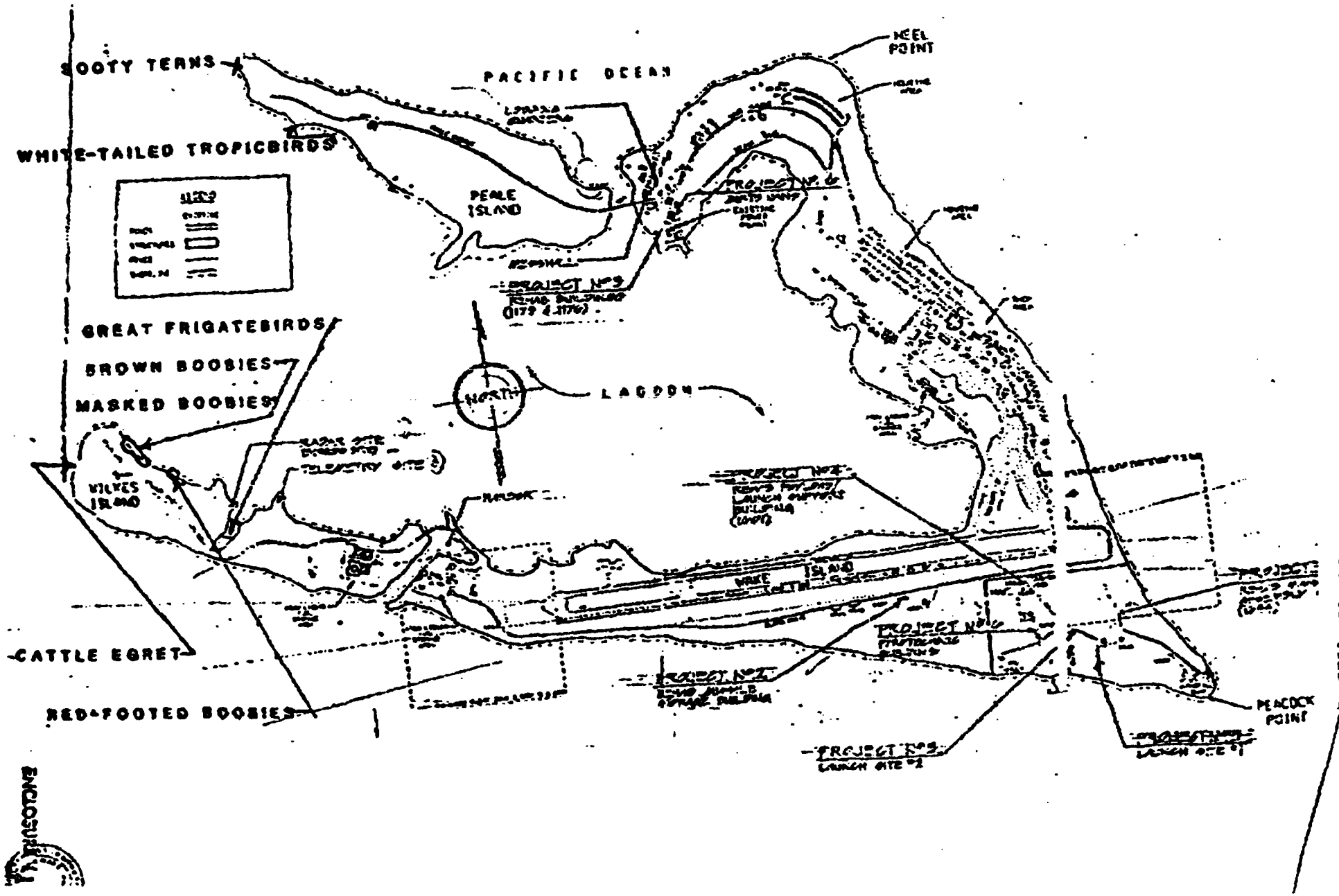
c. No sea turtles were seen during this visit, and no evidence of sea turtle nesting was observed on any of the beaches visited.

d. Two dogs were seen near the mess hall on Wake Island, and numerous feral cats were observed on all three islands.

4. Project Starbird should have minimal impact on the fish and wildlife resources of Wake Atoll.

T. SUTTERFIELD
Fish and Wildlife Biologist

PROJECT STARBIRD



APPENDIX E

DESCRIPTION OF SHORT WAVE ADAPTIVE TECHNOLOGY EXPERIMENT

APPENDIX E

The orbiting Starlab would participate in a Short Wave Adaptive Technology (SWAT) laser experiment that has been developed at the Air Force Maui Optical Station (AMOS) in Hawaii (Fig. 2-11). Characteristics of the lasers used are given in Table E-1. The purpose of the SWAT experiment is to determine wavefront corrections to laser beams that are being distorted when travelling through the earth's atmosphere. This experiment features a deformable mirror at AMOS whose shape can be modified in response to sensed, distorted beam wavefront shapes. The resulting beam, after passing through the atmosphere is a near-diffraction limited beam.

The experiment would employ three laser beams, two from AMOS pointed at Starlab, and one from Starlab pointed at AMOS. During the engagement between Starlab and AMOS, a blue (0.4880 μm) laser beam from SWAT would be pointed toward a retroreflector on Starlab. The reflected signal would be detected at SWAT and its wavefront shape sensed. The sensed signals would be used to correct the deformable mirror shape.

A green laser (0.5145 μm argon ion) laser would then be directed from AMOS toward the entrance aperture of the Starlab optical system. This laser beam's wavefront would have been corrected by the deformable mirror. Starlab would acquire and track this green laser beam and also measure "corrected" green beam characteristics of angle of arrival and centroid position. These measured data would be converted into digital signals that would be used to modulate the Starlab marker laser beam.

The red (0.6328 μm helium-neon) marker laser beam would be pointed toward the SWAT optical entrance aperture. The marker beam would be detected and its modulation data stripped from the beam. The demodulated data would then be used by SWAT as indications of in-space green beam characteristics and also as signals to improve the tracking and focus of the SWAT green beam. Similar tests involving the Relay Mirror Experiment (USAF 1987) have been performed successfully.

Table E-1. Laser characteristics for lasers to be used in Starlab experiments

Characteristic/Parameter	On Shuttle		At AMOS	
	Beacon	Marker	Illuminator	Uplink
Type (material)	Frequency doubled Nd-YAG	He-Neon	Ar-ion	Ar-ion
Wavelength	0.5321 μm (1.06 μm)[a]	0.6328 μm	.4880 μm	.5145 μm
Mode of Operation	Pulsed	Continuous	Continuous	Continuous
Beam Energy at Laser Aperture	200 mJ/pulse	>5.0 mW	4 W	10 mW
Beam Diameter at Laser Aperture	16 mm	17.4 mm	35 mm	340 mm
Beam Divergence at Laser Aperture	60 μrad 50% point	60 μrad	30 μrad $1/e^2$ point	1.7 μrad
Beam Energy off the Pointing Mirror	146 mJ/pulse	0.73 mW		
Beam Diameter off the Pointing Mirror	5.0 cm	80 cm		
Beam Divergence off the Pointing Mirror	23.07 μrad 1/e point	1.9 μrad		
Maximum Energy/Power Density at Laser Aperture	9.2 mJ/cm^2 single pulse	0.37 μW/cm^2		
Maximum Permissible Exposure to the eye[b]	3.44×10^{-7} J/cm^2 multiple pulse; 5×10^{-7} J/cm^2 single pulse	2.55 mW/cm^2	2.55 mW/cm^2	2.55 mW/cm^2
Pulse Width	25 nsec	N/A	N/A	N/A
Pulse Frequency	20 Hz	N/A	N/A	N/A

[a]Infared laser radiation is diverted by two beam splitters into a dump where it is absorbed before leaving the laser. Approximately 0.7 mJ/pulse of the 1.06 μm wavelength radiation goes out.

[b]IRPA (International Radiation Protection Association). 1985. "Guidelines on Limits of Exposure to Laser Radiation of Wavelengths between 180 mm and 1 mm," report of the International Non-Ionizing Radiation Committee of the IRPA, Health Physics 49:34–59.

APPENDIX F

ANALYSIS OF LASER EFFECTS

APPENDIX F

F.1 INTRODUCTION

The term "laser" stands for "light amplification by stimulated emission of radiation." A laser converts light of mixed wavelengths into one or more discrete wavelengths of highly amplified and coherent radiation. Thus laser light is usually only one color, and the light is contained in a "tight beam". Lasers come in many different colors and intensities. In industry today, some lasers are used to cut or drill holes in metals. The use of low-power lasers for ground leveling and surveying operations is fairly common today. The lasers to be carried aboard the Starlab are relatively low powered, and would not burn or destroy objects on earth; in fact they could not even measurably warm objects on the ground surface. Similarly, lasers to be used in the SWAT experiment at AMOS on the island of Maui are relatively low powered and present minimal potential for hazard.

The principal reason to thoroughly evaluate potential effects of lasers is the possible exposure to the eye or skin. Fortunately, several decades of biological studies have taken place during which the effects of light and laser light on the eye have become relatively well understood. Adverse health effects of exposure to laser radiation are of particular concern in the visible and near infrared (400 nm and 1400 nm) where retinal injury can occur, although adverse biological effects are theoretically possible across the entire optical spectrum.

Permissible exposure limits have been derived by a variety of organizations (ACGIH 1982, ANSI 1986, IRPA 1985). For the type of light produced by the Starlab lasers, these organizations have arrived at essentially the same recommendations. A thorough review of the biological effects reported from exposure to optical radiation from lasers was performed by the World Health Organization (WHO 1982). Research summarized in the WHO report provides most of the scientific data base for the development of present day exposure limits developed by the above named and other agencies.

Generally, when setting limits for exposure to a hazardous agent, various value judgments are made. Cost versus benefit is usually employed, including economic impact of controls to limit exposures. The development of guidelines for laser was based only on the scientific data. No consideration was given to economic impact or other nonscientific priorities (IRPA 1985). This appendix deals with the potential effects on or over territories belonging to the United States, foreign countries or territories, or over international waters, and has been based primarily on guidance from the IRPA.

F.2 LASERS TO BE USED IN STARLAB EXPERIMENTS

Two types of lasers would be carried aboard the shuttle, "markers" and "illuminators." A second laser of each type would be available as a backup. The SWAT experiment would involve the most complex combination of lasers in that it would use two ground-based lasers located at

AMOS, an illuminator laser (blue) and an uplink laser (green). Pertinent information related to these four lasers is provided in Table 4.2-1.

To illustrate the type of analyses performed for the BOLT (USAF 1988a) and RME (USAF 1987; 1988b) and to understand important points about Starlab laser illumination of the ground surface, simplified calculations are provided in the remainder of this appendix. The illuminator and marker lasers on Starlab are used in the examples. These examples use basic trigonometric relationships in conjunction with safety guidelines and regulations provided by the USAF [AFOSH 161-10, (1980)], the ANSI (1986), and the IRPA (1985). To facilitate understanding, a variety of assumptions are made to keep the calculations straightforward. For example, although the laser light has a distribution of intensity across a propagating beam front, the light intensity is assumed to be the same across the defined beam diameter.

F.2.1 BEAM DIVERGENCE

When laser light is coming from a great distance (b), it is assumed to be a point source. Even though every attempt is made to prevent laser beams from spreading out (i.e., diverging), all lasers have a measurable divergence. The beam spot of radius (a) is related to the beam divergence (Φ) and the distance (b) (e.g., orbit altitude) by the familiar trigonometric relationship

$$\tan \Phi/2 = a/b$$

which for small values of $\Phi/2$ becomes

$$\Phi/2 = a/b.$$

Therefore, to calculate the area of a laser beam projected from the Starlab—directly overhead onto the ground—only a knowledge of b and Φ are required. The nominal altitude (b) is 324 km and the beam divergences off the pointing mirrors (1/2 point) are 23.07 μrad and 1.9 μrad for the illuminator and marker lasers respectively. For beams projected straight down from Starlab, the corresponding illuminated areas on the earth are based on the area of a circle (A) or

$$A = \pi a^2 = \pi (\Phi b)^2/4;$$

therefore,

$$\text{Illuminator Area} = \pi/4 \times (23.07 \times 10^{-6} \text{ rads})^2 \times (324 \times 10^5 \text{ cm})^2$$

$$= 4.4 \times 10^5 \text{ cm}^2$$

$$= 44 \text{ m}^2$$

and

$$\text{Marker Area} = \pi/4 \times (1.9 \times 10^{-6}\ \text{rads})^2 \times (324 \times 10^5\ \text{cm})^2$$

$$= 2.98 \times 10^3\ \text{cm}^2$$

$$= 0.3\ \text{m}^2.$$

The actual areas illuminating the earth's surface would vary in size and shape according to the location of Starlab with respect to the target on the ground. At one calibration site that is not directly under the flight path, there would be a crossing angle of 28° in addition to the angle from the zenith at which the beam was first transmitted. At the ground calibration sites, Starlab would first send a signal when it came over the horizon and was at 60° to the zenith. At a zero zenith angle, the flight path would still not be directly overhead at one site. It would be 28° from directly overhead. The compound angle from Starlab to this site is given by

$$\Theta = \text{Arctan}\ (\text{Tan}^2\ 28 + \text{Tan}^2\ \text{zenith angle})^{1/2}$$

which goes from $\Theta = 61$ at a zenith angle of 60° to $\Theta = 28$ at a zenith angle of 0°. As the Starlab continued its flight, the compound angle would increase again to 61° as it went over the horizon out of sight.

As the laser projected on the ground, because it was not exactly overhead at one of the sites, the projected surface would actually be an ellipse instead of a circle. The size, shape, and orientation of the axes would change as Starlab passed from one horizon to another. The area illuminated at any time during the fly-over must be considered when examining the beam footprint relative to the safe eye exposure limit. An approximate correction for the projection of the laser beam is made by considering that the circular laser beam projected at an angle on the ground surface, would create an ellipse with the semiminor axis equal to the radius of the laser beam circle (i.e., $\Phi/2 \times b$) and the semimajor axis equal to the laser beam radius divided by the cosine of the angle of projection (i.e., $\Phi/2 \times b/\cos \Theta$).

F.2.2 Atmospheric attenuation

The last major factor which accompanies the description of laser illumination of the earth is that of attenuation. Attenuation is a description of the collective absorption and reflective processes which decrease the beam's intensity. The inverse of attenuation may be considered transmission. In passing through the air, light may be absorbed or scattered by gaseous or particulate materials in the atmosphere; thus, transmission is always less than 100%. Atmospheric transmission studies have resulted in the general relationship of transmission vs angle (Θ). Transmission is given by $T = 0.68^{1/\cos \Theta}$, and values vary from 46% at 60° zenith to 68% at 0° zenith. The transmission factor is applied directly to the initial laser power coming from the pointing mirror because the transmission capacity of the atmosphere directly affects the fraction of laser light which ultimately gets through the atmosphere to illuminate the earth's surface.

The overall energy/power density which would arrive at the calibration site that was not directly under the flight path wiykd be primarily a function of the atmospheric absorption and the distance the laser beam had to expand. The energy/power densities of the two lasers at the ground level at 60° and 0° to the zenith at this site are given by

$$\text{Illuminator Energy Density} \approx \frac{\text{Laser energy} \times \text{atmospheric transmission}}{\text{elliptical area covered by beam}}.$$

Thus, the illuminator energy density (IED) becomes

$$\text{IED}(60°) = \frac{181 \times 10^{-3}\ \text{J/pulse} \times .68^{\,1/\cos 61}}{\pi/4(23.07 \times 10^{-6}\ \text{rads})^2 \times (668\ \text{km})^2/\cos 61}$$

$$= 2.12 \times 10^{-8}\ \frac{\text{Joules}}{\text{cm}^2\ \text{pulse}},$$

$$\text{IED}(0°) = 1.98 \times 10^{-7}\ \text{J/cm}^2\ \text{pulse}.$$

This latter value at zero zenith angle is only slightly below the MPE value of 3.44×10^{-7} J/cm^2 for the multiple pulse situation (ANSI 1986). At 60° to zenith when the laser was first turned on, the intensity on the ground would be about an order of magnitude below the MPE; the semi-major axis of the projected ellipse at 60° is 32 m and the semi-minor axis would be 15 m.

The result of these calculations is to show that, even when viewing the laser light directly in the center of the beam, the light intensity would be below the MPE and thus would not be expected to cause any harm. Likewise, anyone viewing the light from outside the beam would receive much less exposure. Remembering that the laser light is only slightly diverging, the only way to see it if not viewed directly up its path from the space craft, is to see light scattered by moisture or dust particles in the air. The amount of light seen this way would be reduced hundreds of times below that in the actual beam. Thus, even optically aided viewing would not be hazardous for people not within the direct beam.

To determine an exclusion area outside of which safe viewing can take place even with 8X binoculars requires only a knowledge that an 8X optical assistance increases the light intensity by about 64 times. Thus, for the case of Antigua, the illuminator energy density would be increased from 2.12×10^{-8} Joules/cm^2-pulse to 1.4×10^{-6} Joules/cm^2-pulse. In order to reduce this energy density to the MPE requires an additional area of 4 times the size of the 32 x 15 m ellipse is required. The resulting ellipse has semimajor and semiminor axes of about 60 x 30 m. Since the Starlab would be passing over one calibration site at a 27° angle, the "safe" area on the ground would consist of two ellipses (or footprints), one produced coming toward and one produced moving away. They have a common geometric center and an angle of 27° between the long axes. The resulting area encompassed by a rectangle around the two ellipses is roughly 70 x 40 m—essentially the area encompassed by the minimum inner laser safety fence (Fig. 2-7) and well inside the outer laser safety boundary. Small differences resulting from pointing inaccuracies of up to 3.9 μrad would amount to slight changes in the location of the footprint; however, even

extremes in the event of pointing the beam in the wrong direction from the flare would be contained well within the outer laser safety boundary.

It is concluded that no hazard exists for unaided viewing of the laser beam under any circumstances. Further, it would require viewing the laser beam from within the footprint with binoculars to exceed the MPE. This eventuality would be precluded by well-defined physical boundaries. Conclusions based on this appendix are essentially identical to those described in the safety analysis performed by members of the payload design team (PEP-20 1988).

F.3 REFERENCES

American Conference of Governmental Industrial Hygienists (ACGIH). 1982. Rationale for the Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment, (ACGIH). Cincinnati, Ohio.

American National Standards Institute, Inc. (ANSI). 1986. American National Standard for the Safe Use of Lasers. New York.

International Radiation Protection Association (IRPA). 1985. Guidelines on Limits of Exposure to Laser Radiation of Wavelengths between 180 nm and 1 mm. Report of the International Non-Ionizing Radiation Committee of the IRPA. Health Physics 49:341-359.

Lockheed Missile and space Corporation (LMSC). 1989. Inadvertent Exposure of Public or Orbiting Satellites to Laser Radiation. Payload Hazard Report LMSC/F025454-3G1, Phase II, 1-12-89.

U.S. Air Force (USAF). 1980. Health Hazards Control for Laser Radiation. Air Force Occupational Safety and Health Standard (AFOSH) 161-10. Headquarters, USAF, Washington, D.C.

U.S. Air Force (USAF). 1987. Environmental Assessment of the Relay Mirror Experiment (RME). USAF.

U.S. Air Force (USAF). 1988a. Environmental Assessment, U.S. Air Force BOLT Experiment. USAF (February 1988).

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World Health Organization (WHO). 1982. Lasers and Optical Radiation, Environmental Health Criteria 23. Geneva.

APPENDIX G

LETTERS OF CONSULTATION

United States Department of the Interior
FISH AND WILDLIFE SERVICE

3100 University Blvd. South
Suite 120
Jacksonville, Florida 32216

October 25, 1989

Colonel James E. Green, Jr.
Chief, Test & Evaluation Office
U.S. Army Strategic Defense Command
P.O. Box 1500
Huntsville, Alabama 35807-3801

Dear Colonel Green:

This is in response to your October 5, 1989 letter, regarding the Light Management Plan (LMP) for Launch Complex 20 at Canaveral Air Force Station.

On September 19, 1989, Mr. Earl Possardt, Southeastern Sea Turtle Coordinator, met on site with personnel from the U.S. Army Strategic Defence Command (SDC) to discuss Fish and Wildlife Service concerns about artificial lights at the launch complex and the potential for hatchling disorientation and deterrence of nesting activities. Mr. Possardt subsequently learned of two reports of hatchling disorientation caused by lights at Pads A and B on August 8 and 9, in which an estimated 100 hatchlings died. This information was provided to [redacted] of SDC.

The LMP identifies the following lights associated with the launch complex 20:

Pad A -	2-1000 watt high pressure sodium lights on 40 foot pole
Pad B -	2-1000 watt high pressure sodium lights on 40 foot pole
Blockhouse -	1-70 watt wall mounted light
Payload Assembly Building	8-70 watt wall mounted lights
Security Gate	2-150 watt lights
Parking lot	2-250 watt lights

The pole mounted lights at Pads A and B will not be used during the nesting and hatching period (May 1 - October 31). In their place only portable task oriented lights will be utilized. Lights associated with the blockhouse, payload assembly building, security gate, and parking lot are over 2,000 feet from the beach.

ENCL 3

We believe that since the pole lights at Pads A and B will not be utilized between May 1 - October 31 and all other lights are far enough from the beach to prevent direct lighting, sea turtles will not be affected by operational activities at Launch Complex 20. We recommend the following measures to strengthen the lighting plan:

1) tasklights should be restricted to either hand held or those on portable stands less than 8 feet tall and 250 watts or less.

2) strict light conservation should be utilized for the operation of all other lights associated with the Launch Complex 20 between May 1 and October 31.

The Service is appreciative of the cooperative spirit of the Army in addressing endangered species concerns. We remind the Army however, that Section 7 Consultation under the Endangered Species Act of 1973, as amended, is required prior to initiating an action which may affect endangered or threatened species. For instance, the clearing of scrub habitat for the upgrading of the security fence around the launch complex could have adversely affected the threatened scrub jay. Fortunately this was not the case and we believe the Service concerns have been satisfied. With so many endangered and threatened species on Merritt Island we recommend you always check with this office prior to any action affecting the environment. Early consultation will ensure requirements can be met while endangered or threatened species will not be put at risk.

Although this letter does not represent a biological opinion under Section 7 of the Act it does fulfill your obligation under the Act and no further action is necessary at this time. If modifications are made in this project, or if additional information becomes available relating to endangered species, initiation of consultation may be necessary.

Sincerely yours,

David J. Wesley
Field Supervisor

ATTACHMENT #3

FILE 26.33

cc: 1WE
ETR/RF
(LT. AM

FLORIDA DEPARTMENT OF STATE
Jim Smith
Secretary of State
DIVISION OF HISTORICAL RESOURCES
R.A. Gray Building
Tallahassee, Florida 32399-0250
(904) 488-1480

January 21, 1988

In Reply Refer to:

Louis D. Tesar
Historic Preservation Supv.
(904) 487-2333
Project File No. 870655

Mr. David Stone
6550th ABG/DERP.
Department of the Air Force
Patrick Air Force Base, Florida 32925

RE: July 10, 1987 letter and attachments and Subsequent Telephone Conservation with Louis D. Tesar of this Agency, Cultural Resource Assessment Request and Determination of Ineligibility Request, Complex 20 at Cape Canaveral Air Force, Brevard County, Florida

Dear Mr. Stone:

In accordance with the procedures contained in 36 C.F.R., Part 800 ("Procedures for the Protection of Historic and Cultural Properties"), we have reviewed the above referenced project for possible impact to archaeological and historical sites or properties listed, or eligible for listing, in the National Register of Historic Places. The authorities for these procedures are the National Historic Preservation Act of 1966 (Public Law 89-665) as amended by P.L. 91-243, P.L. 93-54, P.L. 94-422, P.L. 94-458 and P.L. 96-515, and Presidential Executive Order 11593 ("Protection and Enhancement of the Cultural Environment").

We are sorry for the delay in our response; however, your request arrived during a period of highwork volume coupled with staff turnover. We have reviewed the comparative information which you provided in your letter and supplemental telephone conversation on Complex 19 and Complex 20 and the proposed work to construct a new launch facility at Complex 20 to meet a portion of any SDI experiment concerning the effectiveness of space-based sensors.

We are aware of the fact that the 1984 study be Resource Analyst, Inc. (RAI) of the cultural resources identified several launch complexes, including Complexes 19 and 20, as potentially eligible for listing in the National Register of Historic Places (NPHP).

In your letter you note that:

> Complex 20 was constructed in 1957 to support the Titan II Missile Program. It was the last of for Titan II launch complexes build on the Cape... The complexes were built from the same basic design, with Complexes 19 and 20 receiving the most recent modifications (Figure 2, Complex 20 As-Build Drawings, and Figure 3, Complex 19 As-Build Drawings).

You further state that:

> The integrity of the complex (20) has been compromised since it was deactivated in 1971. The majority of launch support components, including the service structure and umbilicial (sic) tower, have been removed for used at other complexes or salvaged through the military disposal system. In addition, no historically significant events occurred at Complex 20 and the site is not associated with any famous individual.

Finally, we note that a National Park Services Congressional study team, concurrently with the RAI study, nominated six launch complexes, including Complex 19, for NRHP listing. Subsequently, those six complexes and the Mission Control Center were given National Historic Landmark Status.

Since the integrity of Complex 19 is more intact than Complex 20, and since Complex 19 of these two nearly identical properties was selected for NRHP listing and inclusion as a National Historic Landmark property, we concur with the Air Force in concluding that Complex 20 is not eligible for listing in the National Register of Historic Places. Proposed project activities may therefore proceed at Complex 20 without further involvement with this agency.

If you have any questions concerning our comments, please do not hesitate to contact us. Your interest and cooperation in helping to protect Florida's archaeological and historical resources are appreciated.

Sincerely,

George W. Percy, Director
Division of Historical Resources
and
State Historic Preservation Officer

GWP/ekj
cc: Don George
Ron Anzalone

United States Department of the Interior

FISH AND WILDLIFE SERVICE
300 ALA MOANA BOULEVARD
P. O. BOX 50167
HONOLULU, HAWAII 96850

IN REPLY REFER TO:

SEP 1 1987

Colonel Samuel N. Liberatore
Air Defense Deputy for Operations
U. S. Army Strategic Defense Command
P. O. Box 1500
Huntsville, Alabama 35807-3801

Ref: DASD-H-TF

Dear Colonel Liberatore:

This responds to the referenced letter of August 26, 1987 requesting our review of the draft environmental assessment for the STARBIRD launch facilities project on Wake Island. It includes comments from both Refuges and Wildlife and our Environmental Services offices.

We have reviewed those sections concerning resources within our jurisdiction (animal and plant species) and concur with its conclusions concerning endangered and threatened species; no such species are in the vicinity of, or would be affected by, the project. This assumes that no listed species of sea turtles nest or bask on Wake; to the best of our knowledge, they do not.

The draft indicates that a survey for seabird nests in the area will be conducted prior to construction. We request that such a survey be conducted by a qualified biologist and that the work be coordinated with our Refuges and Wildlife office here. Mr. Jerry Leinecke, District Supervisor for our refuge operations, should be contacted in that regard. Further, to reduce the stress and harassment of seabirds, we request that personnel be generally excluded from the seabird colonies on Peale and Wilkes islands.

Although the remote possibility of a spent rocket falling on a sea turtle at sea (a "one-in-a-million" chance, as stated in the draft) is mentioned, the chances for and impact of a rocket exploding on the launching pad, adjacent land, or in the waters or on reefs surrounding Wake are not discussed. Such an occurrence could have a devastating impact on both the species and the ecosystem on which they depend. These concerns should be addressed in the final assessment.

Thank you for the opportunity to review the assessment.

Sincerely yours,

William R. Kramer

William R. Kramer
Deputy Project Leader
Environmental Services
Pacific Islands Office

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region • Western Pacific Program Office
2570 Dole St. • Honolulu, Hawaii 96822-2396

September 24, 1987 F/SWR1:JJN

Colonel Samuel N. Liberatore
Deputy for Operations
U.S. Army Strategic Defense
Command - Huntsville
P.O. Box 1500
Huntsville, Alabama 35807

Dear Colonel Liberatore:

Subject: Draft Environmental Assessment (EA) for STARBIRD Launch Facilities.

The National Marine Fisheries Service (NMFS) has reviewed the subject Draft Environmental Assessment (EA) for Project STARBIRD, as requested in your letter of August 26, 1987. The proposed project is part of the President's Strategic Defense Initiative and is designed to test the ability of a sensor in space to detect and track ground-launched missiles immediately after they are launched. We offer the following comments for your consideration.

We understand that project engineers have established the requirements for a launch site on the east coast of Florida and another in the western Pacific. The Western Pacific Program Office, NMFS has responsibility for living marine resources and their habitats in coastal waters of Pacific Islands under U.S. Flag. Consequently, we restrict our comments to the proposed western Pacific launch site.

Sites considered initially by the proponent in the western Pacific included Tinian, Roi-Namur, Barking Sands Hawaii, Guam and Wake Island. The site finally selected was Wake Island, because of its suitable location for launch trajectories, and because of potential disadvantages of the other sites, which included environmental issues.

The EA states that Peacock Point on Wake Island has been identified as the specific launch site since a small, abandoned launch complex at the site can be adapted and expanded for STARBIRD use. Consequently, the area has been previously altered by construction, as well as from scrap metal storage, a wet garbage landfill, and two burn areas for disposal of combustible material.

The major concerns of NMFS are the potential for the proposed project to impact nearshore marine resources. However, we feel that the selected site and the planned erosion controls will

minimize any impacts to the marine environment. As stated in the EA, several threatened and endangered species (specifically the green and hawksbill turtle) and marine mammals (spinner porpoise) can be found in the lagoon or coastal waters of Wake. Again, because of the proposed site location and the other mitigating measures, at this time we feel there will be no adverse impact to these resources.

We appreciate the opportunity to comment on the western Pacific launch facility aspect of the proposed STARBIRD project at this early stage of development. Please keep us informed as the project progresses. We look forward to receiving a copy of the Final EA as soon as it becomes available.

Sincerely yours,

John J. Naughton
Acting Administrator

cc: F/SWR, Terminal Is., CA
F/PR, Washington, D.C.
FWS, Honolulu
EPA, Region 9 (P-5)
Corps of Engineers, Hon. District

405:SSH:sh
12 Sept 1989

MEMORANDUM

From: Shirley S. Hihara
PACDIV Code 405, Civil Design Branch

To: Ron Vandagriff
USASDC (CSSD-H-TF)

Subj: USASDC Starbird Launch Complex, Wake Island

Ref: (a) 405:SSH:sh memo dtd 29 Aug 1989

Encl: (1) Advisory Council on Historic Preservation concurrence dtd 30 Aug 1989

1. Ref (a) forwarded to you a copy of PACNAVFACENGCOM letter Ser 09P4/8812 dtd 7 Aug 1989. The letter was addressed to the Advisory Council on Historic Preservation requesting review of the Data Recovery Plan. Concurrence to the letter was made by the Advisory Council on Historic Preservation on 30 Aug 1989 and is provided to you as encl (1).

2. If you have any questions please call me at (808) 474-5374.

Shirley S Hihara

Copy to:

405:SSH

1 SEP 89 16: 19

DEPARTMENT OF THE NAVY
PACIFIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
(MAKALAPA, HI)
PEARL HARBOR, HAWAII 96860-7300

5750(P)
Ser 09P4/ 8812
7 AUG 1989

COPY

AUG 30 1989

ADVISORY COUNCIL
ON HISTORIC PRESERVATION
BY
DIRECTOR, WDPR

AUG 8 1989

Ms. Claudia Nissley
Advisory Council on Historic Preservation
Western Division of Project Review
730 Simms Street, Rm 450
Golden, CO 80401

Dear Ms. Nissley:

A planned construction project will take place within Wake Island Airfield which has been designated the Wake Island National Historic Landmark, a property listed on the National Register of Historic Places (NRHP). The project, entitled "U.S. Army Strategic Defense Command, STARBIRD LAUNCH COMPLEX, Wake Island Airfield" provides modifications and construction as described in the Data Recovery Plan (enclosure (1)).

We believe, that in accordance with 36 CFR 800, that the proposed construction in the vicinity of historical features which are contributing elements of the National Historic Landmark would have no effect on the qualities for which the Wake Island Airfield was designated a National Historic Landmark and listed on the National Register of Historic Places, since they are to be avoided and a monitor shall be present during construction to ensure that they are not inadvertently damaged. We further believe, in accordance with 36 CFR Part 800.9(c), that the affects of the proposed construction and modifications within the National Historic Landmark which might otherwise be found to be adverse can be considered as being not adverse because archaeological or historical subsurface deposits which may be identified during construction are considered of value for their potential contribution to archaeological and historical research and because this value can be preserved through the appropriate research conducted in accordance with applicable professional standards and guidelines. The proposed monitoring is described in the Data Recovery Plan (enclosure (1)).

We request your review of the Data Recovery Plan at your earliest opportunity. Should you have any questions about this matter, please contact Ms. Patricia Beggerly, Archaeologist, Pacific Division, Naval Facilities Engineering Command at 808/471-3088.

Sincerely,

M. N. KAKU
Head, Facilities Planning Department
Acting

Encl:
(1) Data Recovery Plan

Encl (1)

DASD-H-TF

Dr. Tom King
Advisory Council on Historic Preservation
The Old Post Office
1100 Pennsylvania Ave, NW
Washington, D.C. 20004

Dear Dr. King:

Request your comments on the enclosed draft environmental assessment (EA) for STARBIRD launch facilities. This request is made under the provisions of the National Historic Preservation Act, the Endangered Species Act and the National Environmental Policy Act.

The draft EA has been prepared in accordance with Army Regulation 200-2 and contains information required by the Council on Environmental Quality Regulations. We believe this document is sufficient for consultations under the Endangered Species Act and the National Historic Preservation Act.

As we are committed to carrying out our responsibilities to preclude or minimize adverse effects on environmental and cultural resources, the planning for STARBIRD projects has been conducted in an environmentally sensitive manner and various aspects of the project already reflect accommodation of environmental and historic preservation concerns.

Request your comments on the enclosed EA within 30 days. If you have questions, please contact Mr. Dan McCauley at AUTOVON 742-4824 or commercial (205) 895-4824.

Sincerely,

SAMUEL N. LIBERATORE
Colonel, Air Defense
Deputy for Operations

Enclosure

United States Department of the Interior

FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS OFFICE
P.O. BOX 50167
HONOLULU, HAWAII 96850

OCT 25 1989

Dr. John R. Edwards
Environmental Planning Division
Directorate of Acquisition Civil Engineering
Headquarters Space Division
Los Angeles Air Force Base
Post Office Box 92960
Los Angeles, California 90009-2960

Dear Dr. Edwards:

This replies to your October 19, 1989 request for our concurrence with your determination that the Starlab Project will have little, if any, impact on any listed species.

The project is to be located, in part, at the Air Force Maui Optical Station on Mount Haleakala, Maui, Hawaii. In that three endangered species are known to be found in the vicinity of the Station (Hawaiian hoary bat, Hawaiian goose, and Hawaiian dark-rumped petrel), the Environmental Assessment enclosed with your letter evaluated the potential that they would be affected by the project; it concludes that the project would have little, if any impact on them. Your letter further concludes that as a result of this determination, formal consultation as described in Section 7 of the Endangered Species Act is not required.

We concur with your finding that the project would be expected to have little, if any, impact on any listed species. Formal consultation under Section 7 is not required unless (1) significant changes are made in the scope or impact of the project, (2) new species are listed which may be affected by the project, or (3) additional pertinent information regarding the three species listed above becomes available which demonstrates that the project may affect them in ways or degrees not addressed in your Assessment.

Thank you for the opportunity to review the Environmental Assessment.

Sincerely yours,

Ernest Kosaka

Ernest Kosaka
Field Office Supervisor
Office of Environmental Services

APPENDIX H

U.S. ARMY STRATEGIC DEFENSE COMMAND

LIGHT MANAGEMENT PLAN
VERTICAL LAUNCH COMPLEX 20
CAPE CANAVERAL AIR FORCE STATION

November 1989

PREPARED BY

TELEDYNE BROWN ENGINEERING
CUMMINGS RESEARCH PARK
300 HPARKMAN DRIVE NW.
P.O. BOX 0700007
HUNTSVILLE, ALABAMA 35807-7007

U.S. ARMY STRATEGIC DEFENSE COMMAND

LIGHT MANAGEMENT PLAN
VERTICAL LAUNCH COMPLEX 20
CAPE CANAVERAL AIR FORCE STATION

16 November 1989

PREPARED BY

TELEDYNE BROWN ENGINEERING
CUMMINGS RESEARCH PARK
300 SPARKMAN DRIVE NW.
P.O. BOX 070007
HUNTSVILLE, ALABAMA 35807-7007

LIGHT MANAGEMENT PLAN

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this plan is to provide night specific guidelines for the operation of lights at LC 20 by the U.S. Army Strategic Defense Command. These lights are known to adversely affect threatened and endangered sea turtle nesting activity on the Cape Canaveral Air Force Station (CCAFS) coastal beach. This action is required to reduce, to the maximun extent practicable, the incidental take of the sea turtle hatchlings resulting from disorientation caused by direct and indirect lighting generated from various facilities on CCAFS. Development and implementation of this plan is an obligatory action to comply with the recommendations put forth by the U.S. Fish and Wildlife Service (USFWS) during consultation with the Air Force in accordance with section 7 of the Endangered Species Act of 1973, as amended. The directive described in this Plan will be executed during the annual CCAFS sea turtle nesting season (1 May - 31 October). Sea turtle hatching usually does not occur until late June. Research indicates that artificial lighting adjacent to coastal nesting beaches deters nesting females from approaching the affected section of beach; therefore, the initial effective date of the plan was expanded to include early beach selection and next laying activity. In addition, it is recommended that the directives included in the operational plan be implemented throughout the year to facilitate the Air Force Energy Conservation Program described in AFR 18-1, Air Force Energy Management. Both programs, energy conservation and endangered species protection, are mandated by federal law and all directives, such as this plan, must be adhered to by all CCAFS tenants, users and contractors.

1.2 OBJECTIVE

The objective of this plan is to reduce light sources that are known to disorient sea turtle hatchlings migrating to the ocean after emerging from the nest. Additionally, preliminary research indicates that lights adjacent to sea turtle nesting beaches, may hinder the beach and nest site selection of nesting females. Therefore, this plan will describe light use methodologies directed toward reducing the adverse impact of facility lighting on nesting and hatchling sea turtles.

The preferred method of reducing direct and indirect light on the beach is to eliminate the light source. In most cases, this cannot be entirely achieved due to safety, security and operational requirements. A survey and evaluation was conducted to identify any lights which could be eliminated without adversely affecting these requirements.

Recommendations regarding the fate of each light surveyed at Complex 20 are as follows:

1. elimination of the light
2. reduced intensity, directing lighting away from the beach
3. controlled use, and
4. no action

This plan also covers light operation requirements and/or pre-launch situations where use of individual lights are authorized. The plan will serve as a basis for developing an operations manual for exterior lights for building tenants and facility users. Compliance with the guidelines for operation of lights will be a requirement of all DoD and contractor personnel.

2.0 DESCRIPTION

2.1 LAUNCH PAD A

There are two manually switched high pressure sodium vapor 1000 watt, pole mounted, flood lights on the beach side of the pad directed away from the beach with NEMA 2 light distribution. These are located 700 ft. from the beach.

2.2 LAUNCH PAD B

There are two manually switched high pressure sodium vapor 1000 watt, pole mounted, flood lights on the beach side of the pad directed away from the beach with NEMA 2 light distribution. These are located 1400 ft. from the beach.

2.3 BLOCKHOUSE (LAUNCH SUPPORT CENTER)

One high pressure sodium vapor 70 watt, wall mounted-light with manual switch is located on the side of the building away from the beach at the equipment room.

2.4 PAYLOAD ASSEMBLY BUILDING

There are eight high pressure sodium vapor 70 watt, wall mounted lights, are located around the perimeter of the Payload Assembly Buildings, with photocell switches. In addition, there are two 150 watt directional lights at the security entrance gate into Complex 20 and two 250 watt, asymetrical light, distribution lights in the parking area just outside the gate.

3.0 MODIFICAITONS

Since the modification of Complex 20 facilities and construction of the Launch Pads A and B considered light management during design, no additional modifications are planned.

4.0 OPERATIONAL CONTRAINTS

4.1 LAUNCH SITES A AND B

The 40ft high exterior flood lights at both Launch Pads A and B are directed away from the beach and operated by manual switches. Since both launch pads are within the security fence around Complex 20, they are not required for security purposes. Personnel will not be permitted to utilize these aerial flood lights during the turtle nesting season of 1 May to 31 October. When lighting is required, it shall be portable task lighting, pointed away from the beach and considerably lower to the ground than the 40ft lights. Exterior lights will be used only when necessary on an "as needed" basis and extinguished when no longer required to support outdoor work or provide personnel safety.

4.2 BLOCKHOUSE (LAUNCH SUPPORT CENTER)

The exterior light at the mechnical equipment area will be used on an "as needed" basis by maintenance personnel working in and around the mechanical equipment room, since the manual switch is in the mechanical room. Nor is it required for security, since the blockhouse is within the security fence around Complex 20.

4.3 PAYLOAD ASSEMBLY BUILDING

The exterior lights around the perimeter of the building, the security entrance gate and parking are of low intensity and being over 2000 ft. from the beach, these lights should have no threat to the turtle disorientation.

4.4 GENERAL CONSTRAINTS

Research shows the most effective method of reducing the adverse effect to sea turtles from artificial light is to remove the source. In most cases, the lights currently existing on CCAFS buildings and structures are periodically required to support night activities, provide security visibility and/or enhance personnel safety. The launch pads' exterior lighting was evaluated on providing minimum levels and directing them away from the beach. For the lights which cannot be eliminated, the second most effective method is the controlled use of the light, restricting its operation to an "as needed" basis.

Therefore, the following operational constraints will be implemented upon approval of this plan.

- Personnel access door lights will be turned on only for those areas which will be utilized during a designated night shift.
- The access door lights will be extinguished by shift personnel upon completion of the shift and checked by the shift supervisor.
- Area floodlighting will be used only as required to support activity in that immediate area. It will be the responsibility of personnel requiring the use of these lights to extinguish them upon completion of the activity.
- Mechanical equipment area lights will be used only when night activities or inspections require that these areas be lighted. Personnel working in these areas will be required to extinguish the light(s) upon completion of their required task.
- Launch pad 40ft high aerial lights will not be used during the turtle nesting period of 1 May to 31 October and only turned on as required to support operations in those areas the remaining months. During the period of 1 May to 31 October and other time as needed, portable task lighting, pointed away from the beach and considerably lower than the 40ft lights, will be used. It will be the responsibility of the site foreman and/or shift supervisor to ensure the lights are extinguished upon completion of the operation.
- No launch pad or blockhouse exterior lights will be used for security surveillance purposes. Any lights being used will be extinguished by the user immediately upon completion of their requirement for that light.
- Security lights at the Complex 20 entrance gate and the adjacent parking lot will be turned on when night activities in Complex 20 are required. It will be the responsibility of the security guard to ensure the lights are extinguished when the gate is secured.

5.0 COMPLIANCE VERIFICATION

Building custodians and the managers of the facility user organization(s) will be ultimately responsible to ensure compliance by site personnel. Site security officers will record non-compliance during routine security inspection/patrols. The responsible persons will be notified.

In addition, Launch Base Support (LBS) Contractor, Environmental Engineering personnel will conduct unannounced evening inspections of Complex 20 to ensure compliance with the plan and the OMEL. Further, the U.S. Fish and Wildlife Service will be conducting onsite inspections coordinated through the 6550th ABG/DEEV to verify compliance and make recommendations for changes or revisions in this plan and/or the OMEL. Revisions to this plan will be made as needed or required to further reduce the incidental take of threatened or endangered sea turtle hatchlings on the CCAFS coastal beach.

APPENDIX 1

List of Abbreviations

CCAFS	Cape Canaveral Air Force Station
DoD	Department of Defense
LBS	Launch Base Support
OMEL	Operations Manual for Exterior Lighting
USFWS	United States Fish and Wildlife Service